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WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

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ABC

WORLD OIL

Established 1916 as THE OIL WEEKLY

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HE OUGHT TO KNOW BETTER

IF WE ARE to take President Truman's message to the Congress on tax matters early in January and from it gauge the breadth of his mind as a person who understands the broad, but basic problems of finance, we cannot escape the conclusion that he has shown no improvement from the days when he was in the process of failing in the haberdashery business in Missouri several years ago.

American industry is faced with the need of very heavy capital expenditures during the next five years . . . probably as much as $100 billion, of which the oil industry's share is large. In an editorial in the November issue of WORLD OIL we pointed out that a hostile attitude in the White House towards industry would make it very difficult to channel this additional money into investment in industrial concerns, whether they be big or small. We also pointed out that even with a friendly attitude existing in the government, it was uncertain that this much money could be drawn into industrial stock investment or even in loans.

To the person who will stop for a moment and consider, certain things stand out like a sore thumb. A prosperous industry means jobs, satisfactory jobs. A prosperous industry means an industry which can keep its plants in modern condition, and which can expand to meet the opportunities offered. With our annual gain in population more jobs must be provided or we will be in the shape of some countries whose names we all can call. An unprosperous, decadent industry, certainly will mean less jobs.

Nobody but a communist who thrives on bad times and chaos should wish for a period of depression or unprosperous times.

Now, with inflation, a part of which will surely remain with us, because no one we know thinks that wages will ever, for any material period at least, be lower than they now are, every industrial concern in these United States is finding it necessary to replace old and less expensive equipment with new and far more costly equipment. And the sad thing is that in a great many cases the new and more expensive equipment is little if any more productive than the old equipment which originally cost half of its replacement value. This means in many cases, that insofar as industry is concerned, it will take more money to stay in business on an original scale than it did to go into business in the beginning.

All of which gets back to the conclusion that even Mr. Truman should be able to see: if industry's profits are syphoned off in an increasing manner, it not only will have less of its own funds to invest in its own enterprises, but it will find it increasingly difficult to get the public to invest. And that can easily mean a slowdown which neither management nor employes want.

Yet President Truman, with a true politician's lack of farsightedness, and in an obvious attempt to bid for the votes of the very people whose jobs he would put in jeopardy, proposes an additional tax burden of more than $3 billion annually on industry through increased income taxes.

No one should be surprised that he "went busted" selling neckties!

Undoubtedly, many will excuse the President by saying that his talk was mere political thunder, but that is exactly what we are complaining about. It is a dangerous electrical storm with which he is playing. We could excuse it in somebody across the water, but any American, particularly a president, whether he became one by accident or not, should have more sense and should exercise it.

Ray L. Dudley

HERE IS THE SOLUTION OF A DIFFICULT *Problem!*

It has always been difficult to perform a successful cement job at some desired point above the bottom of the hole — and at the same time prevent contamination by the cement slurry of permeable, low-pressure zones below the cementing point.

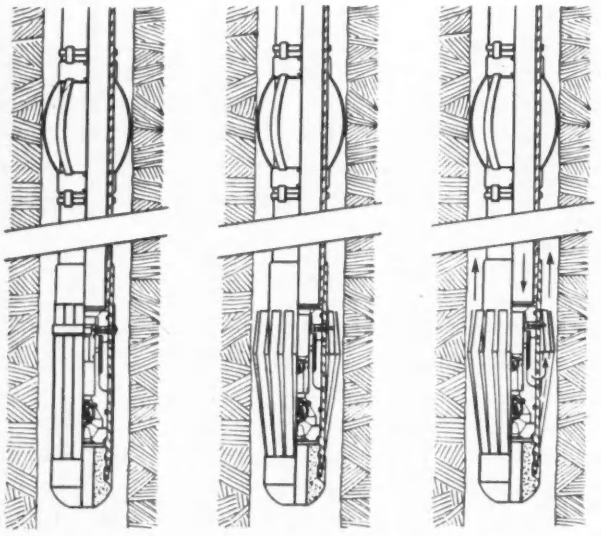
This operation is now safely and efficiently performed by using the Baker Triplex Cementing Shoe (Product No. 136) or the Baker Triplex Cementing Collar (Product No. 138) which is similar in internal construction and in operation to the Triplex Shoe.

The simple operation of TRIPLEX Equipment is evident from the accompanying drawings which illustrate the ease of floating-in casing strings of any size or length — the efficient distribution of the cement slurry — and the protection of permeable, low-pressure zones below.

Get in touch with the Baker representative in your area for prompt, helpful service.

BAKER OIL TOOLS, INC.

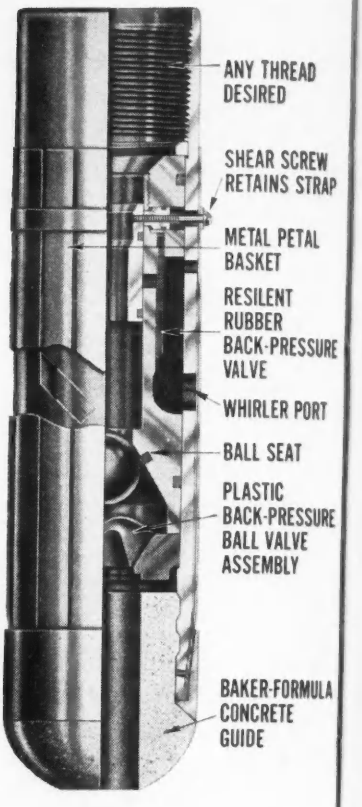
HOUSTON • LOS ANGELES • NEW YORK

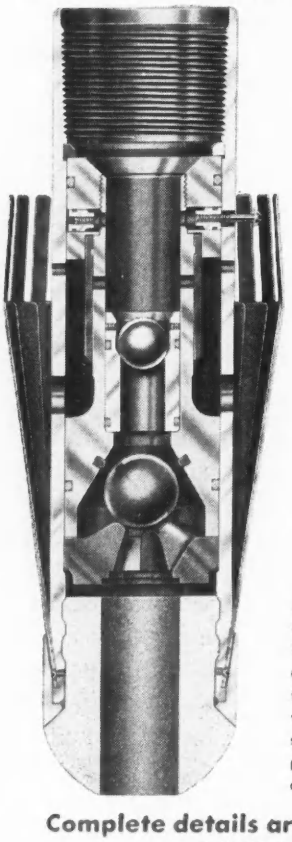


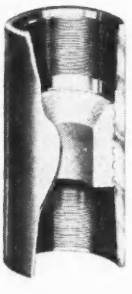
The Baker Triplex Cementing Shoe (left) in running-in position, centered in the hole by a Baker Casing Centralizer. In the center illustration the Tripping Ball has been dropped, seated, and the Tripping Valve forced downward. This action shears the shear screw holding the Metal Petal Basket against the Shoe, and permits the Metal Petal Basket to expand against the side walls of the hole. The ports are now open ready for cementing. At right, cementing is under way, with the slurry directed upward to completely encase the centered pipe with a uniformly thick body of cement with the expanded Basket retaining the cement above the Shoe.

The Baker Triplex Flapper Valve Float Collar (Product No. 134) may be run in place of the Triplex Baffle Collar when an additional float valve is desired. Note how it is designed to permit passage of the Tripping Ball, and how an ample flat surface is provided for "bumping" the cementing plug.

At right the Triplex Shoe is shown in running-in position, with the Metal Petal Basket held against the Shoe by the hold-down strap which is fastened by a shear screw.







The Triplex Cement Baffle Collar (Product No. 137) is run a joint or two above the Shoe and serves as a stop for the cementing plug, so that mud-contaminated cement is retained inside of the casing. The hole is bevelled at its top to permit easy passage of the Tripping Ball.

(Left) The Tripping Ball has been dropped and seated on top of the Tripping Valve. Pressure of about 500 psi has sheared the shear screws and forced the Tripping Valve down to expose the cementing ports. Shearing the screws also permits the Metal Petal Basket to expand against the side walls and form a bridge which holds the cement slurry above the Triplex Shoe and protects permeable, low-pressure zones below from cement contamination.

Complete details are in the 1948 Baker Catalog — and THE COMPOSITE CATALOG

BAKER TRIPLEX CEMENTING EQUIPMENT

The Changing Panorama

Oil Shortage Answer: Steel and More Steel

THE WARNING of Secretary Krug of the Department of the Interior regarding scarcity of petroleum products in the U. S. in 1948 is well taken.

The domestic oil supply situation is serious enough now in a time of peace but should our country be threatened with war it could well be disastrous. When World War II was in prospect we knew that the oil industry could do its full part, with proper allocation for drilling, and we found during the war that it came up to full expectations even with drilling drastically reduced.

But now the situation has changed. The "fat" which had been accumulated through over-drilling in prewar years has been consumed. Domestic demand in peacetime now exceeds wartime demand. Pipe is so scarce that necessary drilling campaigns planned for 1948 will have to be cut.

A genuine emergency exists, and the cure we see for it is not a job of rationing, but rather a job of increasing production which can be done if pipe can be had for drilling and steel can be provided for refineries.

Why not cut to the heart of the matter, Secretary Krug, and do something about allocation of every possible ton of steel to the oil industry?

Boom Will Continue, Executives Believe

HOW LONG will the boom last?

At least through 1948, according to many of the nation's top business men.

In a poll of 28,200 executives, the magazine *Fortune* found that 60 percent expect the boom to continue at the present level or higher in 1948. Only 37 percent expect a moderate downturn. About 90 percent expect to keep their present payrolls or boost them.

Almost none of them expect to lower prices in the next six months. An outstanding exception to this attitude toward prices is General Electric. GE announced an average price reduction of 5 percent on a wide range of its products for an estimated saving to its consumers of $50 million in 1948.

President Charles E. Wilson declared the reductions were in the hope of helping to reverse the inflationary spiral and inspire other companies to make reductions, too. If *Fortune's* poll is correct, GE will inspire practically nobody to follow suit.

What If Petrillo Organizes Valets?

WHEN THE president of an oil company aims a barrage of snappish verbs and blazing adjectives at the arrogant head of a musicians' union—that's news.

Likewise, the reasons behind the verbal roasting present a sorry commentary of an indifferent public being led into a shameless situation by an egomaniac in command of a labor union.

Sun Oil Company planned a Christmas party for its employes at Philadelphia and a part of the program was to have been a concert by the company orchestra. But the musicians' union, following a rule of its boss, Czar Petrillo, insisted that a professional orchestra "stand by" during the concert. Whereupon President Robert G. Dunlop of Sun canceled the company orchestra's participation rather than pay tribute to the musicians' union.

Dunlop compared the union's action with the trend toward curtailment of individual liberties in other parts of the world. "It is our earnest hope that each of us as individuals will become so aroused over such conditions as this that both individually and collectively we will do everything in our power to return to this nation conditions which are conducive to the full enjoyment of individual liberty and freedom of choice."

There was nothing new in the ridiculous demand of the musicians' union or in President Dunlop's refreshing "to hell with you" comeback; but the incident is a new reminder that all of us are perilously close to being forbidden to put on our own pants every morning unless a member of a labor union "stands by"—and with his hand in our pocket!

So You're Working For the Government

PERHAPS PART of the public's indifference to our astranomical tax bill can be attributed to the average mind's inability to grasp such huge figures and break them down into a personal burden.

Proponents of government economy and tax reduction would win greater support from Mr. and Mrs. America if, instead of demanding that taxes be cut from umpty-umpty-umpty billions to a mere umpty-umpty billions, they would demand that the average man's taxes be trimmed from 31 cents on the dollar to 30 cents or some such.

John Q. Anybody is prone to shrug his shoulders when told how many thousands of employes swarm the beehive of government bureaucracy but he would get riled soon enough if this national scandal were reduced to small digits he could grasp with one clutch of his mind.

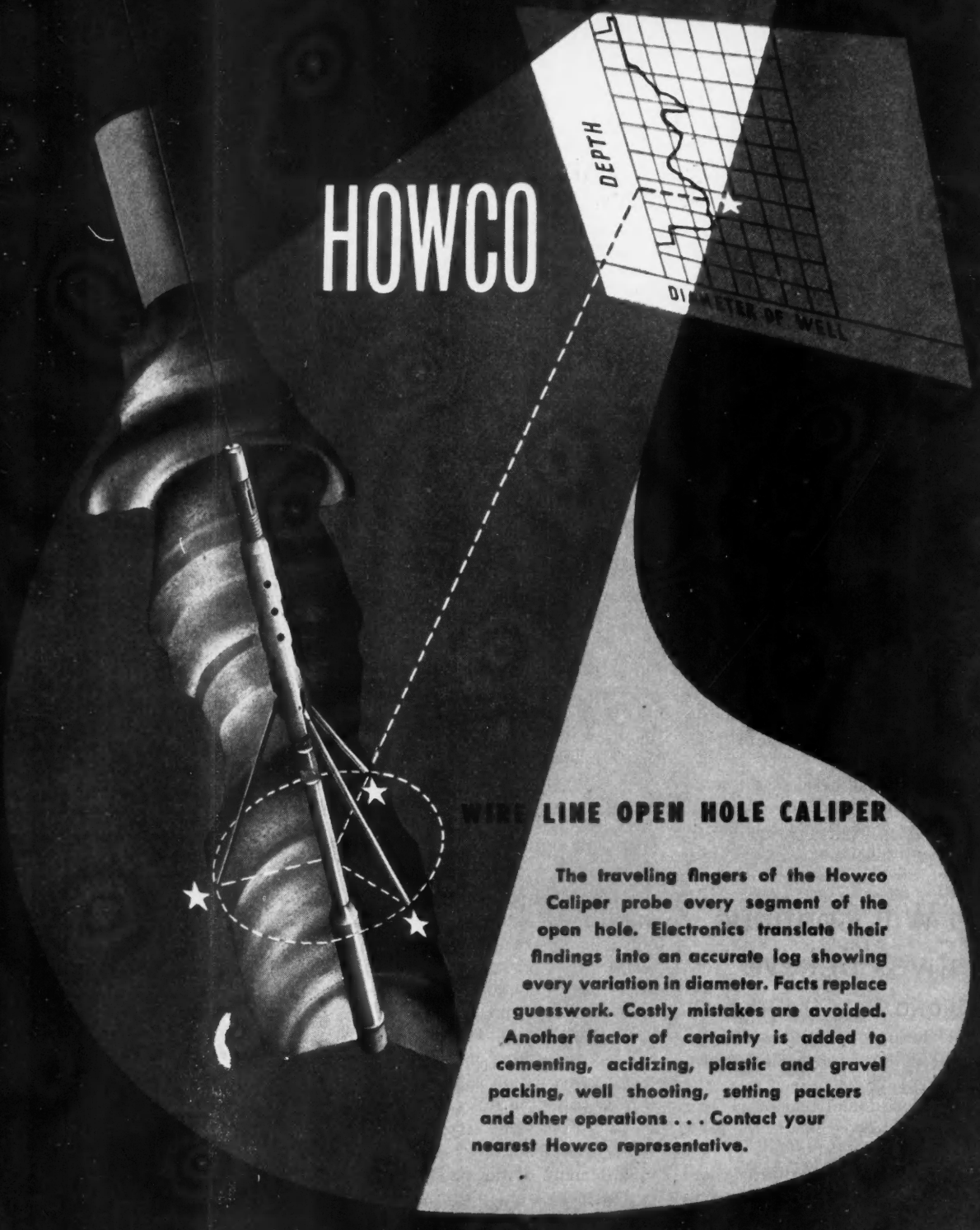
Tell him that his pay for a week and three days out of every month goes to the government. Tell him his earnings for 3¾ months out of every year are spent for the privilege of being governed. Tell him that if his 20-year-old son gets a job tomorrow with the intention of retiring when he is 60, that the government will take the fruits of 12½ years of his 40-year working life unless taxes are in the meantime reduced.

He might also be interested to know that the amount he pays for being governed exceeds the total income of the average person living outside the U. S.

A comparison between John Q. Anybody's taxes and those of his father and grandfather might also be enlightening. His old granddad, who was a salaried man before the Civil War, paid less than 5 cents on the dollar in taxes, compared with the 31 cents being whacked off now. After the Civil War, granddad's taxes gradually mounted to 9 cents on the dollar. After World War I, dad's taxes mounted to about 13 cents. During the 30's the figure ran up to around 25 cents.

Presented with simple figures like these, it's just possible that John Q. Anybody might get mad and set a bear trap in the government pork barrel.

HOWCO



WIRE LINE OPEN HOLE CALIPER

The traveling fingers of the Howco Caliper probe every segment of the open hole. Electronics translate their findings into an accurate log showing every variation in diameter. Facts replace guesswork. Costly mistakes are avoided. Another factor of certainty is added to cementing, acidizing, plastic and gravel packing, well shooting, setting packers and other operations . . . Contact your nearest Howco representative.

HALLIBURTON OIL WELL CEMENTING CO.

DUNCAN, OKLAHOMA

MONTHLY NEWS ANALYSIS

LONG-FEARED FUEL SHORTAGE HERE . . . NPC ADOPTS VOLUNTARY SUPPLY PROGRAM . . . SYNTHETIC FUELS GIVEN MORE ATTENTION CRUDE OIL PRICES MAY JUMP AGAIN . . . MORE STEEL IS POSSIBLE

Acute Fuel Shortage May Bring On Federal Control

The long-discussed possible fuel oil shortage became an actuality the past month—and an acutely critical one, as exceptionally heavy snow storms and prolonged cold weather hit the upper Atlantic Seaboard and Midwest, causing demand for burning oils to soar to unprecedented levels.

The immediate results: imposition of voluntary consumer distribution controls somewhat reminiscent of wartime regulations; adoption of plans for increasing refinery output of fuel oils; stepping up of the campaign to get consumers to conserve fuels, with the government now doing as much urging as the oil companies; and the focusing of greater attention on the nation's fuel supply than ever before.

In prospect were the possible reestablishment of government distribution and price controls; government administration officials urging the passage of an anti-inflation bill to make this possible; and intensified government study of every phase relating to the petroleum supply situation.

Since it would be a rather easy step from a system of coordination and cooperation to a system of government enforcement, many feared federal control of the industry would be the ultimate result.

Stricken Areas Establish Fuel Coordinating Agencies

Worst hit region, both by the cold weather and fuel supplies, was the very heavy consuming North Atlantic Seaboard area. The situation in this territory was unsatisfactory prior to the wave of low temperatures, East Coast refiners having had but 13 million barrels of light fuel oils, including heating oils, in storage as compared with slightly more than 22 million barrels a year ago.

When cold weather struck, supplies ran low and delivery trucks bogged down in the snow, leaving many homes temporarily without fuel. Emergency around-the-clock delivery methods proved insufficient to take care of all requests.

The situation resulted in an enormous backlog of delivery orders, and prospects were that these could not be corrected immediately despite all efforts.

State officials throughout New England, the Middle Atlantic, and the Midwest areas quickly appointed fuel oil coordinators and commitees to work with oil companies in devising supply allocation programs. Some of the larger cities did likewise. Emergency fuel pools were established in some of the worse affected areas to handle hardship cases. General result was the cutting of deliveries by 15 percent as a means of providing equitable distribution of available supplies.

Oil companies immediately intensified their three-month-old campaign for voluntary consumer conservation of fuels, on which they are spending $1½ million.

Consumer Reduction Of Use Declared Necessary

Into the picture quickly moved the federal government, calling on the public to reduce consumption of gasoline, fuel oil and gas by 15 percent.

On January 3 President Truman issued an executive order assigning to the Interior Department the responsibility for agreements on voluntary consumer controls on the use of petroleum and petroleum products, natural and manufactured gas, coal and coke. Interior Secretary Krug on January 15 told an emergency conference of fuel coordinators from more than 20 states that voluntary consumer curtailment was necessary not only to "relieve current shortage" but to prevent a continuation of the critical supply problem "for four or five years."

Krug's program for accomplishing this reduction was reminiscent of wartime days, calling for: (1) stopping installation of oil or gas burning equipment; (2) conversion of industrial plants using oil to coal wherever possible; (3) keeping room temperatures at 68 or below during waking hours and at 60 degrees or less at other times; (4) cutting of gasoline use by forming car pools, driving slower and reducing mileage traveled; (5) installing of weatherstripping and insulation to save fuel; and (6) using of less hot water and keeping shades or blinds closed to seal in heat.

Industry Adopts Program To Relieve Shortage

The National Petroleum Council January 22 unanimously adopted a voluntary industry program, which when approved by the Department of Justice is expected to improve greatly the supply and distribution situation, particularly with respect to heating oils. The program adopted was recommended by a special committee appointed two weeks previously to study the problems.

So far as the petroleum industry itself was concerned, the shortage resolved itself into these problems: (1) ways of increasing supplies of middle distillate fuel heating oils; (2) insuring equitable distribution of supplies, and (3) means of temporarily reducinig the demand.

The program adopted by the NPC called for: (1) establishment of crude production allowables equal to maximum efficient rates in each state east of the Rocky Mountains; (2) maximizing of refinery crude runs east of the Rocky Mountains during the next 60 days, even to the extent of reducing crude oil inventories substantially; (3) refineries east of the Rocky Mountains should further adjust upward the yield of distillates at the expense of gasoline during the next 60 days; (4) imports of crude should be increased if possible; (5) added tanker capacity should be made available; (6) all companies should adopt a seven-day week loading and unloading of tank cars; (7) exchanges and short term loans of petroleum products should be extended to save transportation; and (8) exports should be limited as much as possible.

The NPC program also urged that

the fuel conservation program be stimulated, that the rate of demand growth of middle distillate be checked, urged that consumers conserve gasoline as well as fuel oil, and at the same time declared the industry had to have sufficient steel to continue its expansion program.

This action was the industry's answer to the Truman administration plea for government authority to freeze petroleum prices and set up federal allocation and rationing systems. It was generally believed that the council's action would forestall for 60 to 90 days the imposition of government controls. The success of the industry's program during that period probably will determine further action.

The necessity of the industry doing all it humanly can to provide increased quantities of heating oils, presaged a gasoline shortage next summer. Further adjustment upward of distillate fuel oil production, as recommended by the NPC committee, can be accomplished only by cutting down the refinery yield of gasoline. The committee recognized that such action would shift the supply problem from fuel oils to gasoline, but said it felt such a recommendation to be in the public interest.

Gasoline stocks for the nation as a whole were nearly 2½ million barrels greater on January 17, 1948, than a year previous, but all this increase is in the Texas Gulf Coast region. All other regions have slightly less gasoline on hand now. In view of increased demand this situation makes the summer gasoline situation gloomy.

Federal Government Shows Great Concern Over Shortage

The fuel shortage, coupled with fears of what would happen if cold weather continued in the Atlantic and Midwest states and with reports of "black market" prices being charged by some small marketers during the crisis, focused the attention of many federal government officials on the oil supply situation.

The very first speech on the House floor as the new session of Congress began urged an "immediate and sweeping" investigation of the "entire fuel oil situation." Other members of the House and Senate immediately pressed for probes of petroleum prices and supply, some urging that the Justice Department's anti-trust division get busy. Resolutions calling for such investigations were introduced in both congressional houses. Several of the dozen or so congressional committees and subcommittees which had been studying the petroleum situation for months promptly renewed their investigations.

In the midst of the foregoing early January developments, President Truman in his budget message to Congress asked that more funds be appropriated for various government petroleum work, particularly for a $30 million three-year expansion of the government synthetic liquid fuels program. Truman described the depletion of the U. S. petroleum reserves as one of the nation's "most serious and far-reaching problems."

Testifying at a Senate banking and currency committee hearing on anti-inflation legislation, Secretary Krug on January 14 declared that if he had the authority to do so he would immediately freeze petroleum prices from top to bottom for a 60-day period. He said recent price advances made such controls necessary to combat inflation.

Five days later, Defense Secretary James Forrestal told the House Armed Services subcommittee that U. S. oil production would be 2 million barrels per day short of meeting the nation's military and civilian needs in case of another major war.

Synthetic Fuels Given Greater Attention

The extreme tightness of the supply situation, coupled with a growing realization that it could not be corrected at any early date, resulted in an intensified interest in the development of synthetic liquid fuels.

Coupled with his urging that the American people adopt a voluntary petroleum conservation program, Secretary Krug emphasized the need for increasing "the entire energy output of the U. S., particularly through intensification of the development of synthetic oils and expansion of the hydro-electric program as a source of energy to replace petroleum." A few days after stressing the need for additional work on synthetic fuels in his budget message, President Truman again emphasized the importance with which he holds such development when he delivered his annual economic report to Congress. On the latter occasion, Truman, in referring to petroleum, stated "new techniques and sources of supply from coal, natural gas and oil shale will have to be increasingly relied upon to prevent the (petroleum) reserve situation from deteriorating and to meet the rapidly growing demand."

When telling a House subcommittee that there would be a 2 million barrel per day shortage of petroleum for another major war effort, Secretary Forrestal urged immediate commencement of a synthetic liquid fuels development program. A synthetic fuels industry, he said, would be "the greatest known reserve" in this country.

During the month, Stanolind Oil & Gas Company announced it would build an $80 million natural gas synthesis plant in the Hugoton, Kansas, field. The plant, expected to be completed in early 1950, will process 100 million cubic feet of gas daily and produced 7000 to 8000 barrels of gasoline and fuel oil. This will be the second plant of this type in the U. S. A 7000-barrel capacity plant is under construction at Brownsville, Texas.

It also was revealed that the Department of Interior plans to build a $3 to $4 million Fischer-Tropsch 50-80 barrel capacity demonstration plant at the Louisiana, Mo., ordnance works if Congress votes additional funds to continue the synthetic liquid fuel research program.

Synthesizing of liquid fuels from gas, coal and shale was a topic of much discussion at a three-day ceremony dedicating a new Esso (Standard Oil Development Company) research laboratory at the Baton Rouge, La., refinery of the Louisiana division of Standard Oil Company of New Jersey. Shown to the public for the first time were 40 experimental pilot plants, of which half a dozen are working on gas synthesis, including one 10-barrel per day plant, the largest in this country.

Esso research heads declared gasoline made from natural gas was competitive in cost today with gasoline made from $2.50 per barrel crude.

Despite intensified interest, research progress and natural steps toward gas synthesis, the building of any sizable synthetic fuel industry in the U. S. still appeared unlikely for sometime to come. Too much investment is the chief obstacle. To build a gas synthesis plant costs from $4000 to $5000 per barrel, compared with about $2500 cost per barrel for a crude oil refinery. Therefore, to create a very modest daily capacity of even 100,000 barrels would require a minimum investment of $400 million. Furthermore, such plants constructed now run an exceptionally heavy risk of being obsoleted quickly by new technical advancements.

Price Of Crude Oil May Take New Jump

As consumers and government officials were denouncing rising petroleum prices, the greatest thirst for oil products ever known was once again setting up conditions which usually cause posting of higher crude prices, and which in turn cause increases in prices charged for petroleum products.

Despite having scored the sharpest jump in two decades only last month, which hoisted crude prices to a level almost $1 per barrel higher than at the beginning of 1946, oil men began to fear another crude price increase was in the offing.

New higher prices have failed to

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check the payment of premiums above posted prices by smaller refiners and other purchasers. When major refiners begin to lose their crude connections to premium payers, history shows that a general boost in the price can be expected and there are increasing indications that producers are currently selling larger quantities to those offering premiums.

Labor Strikes Also Curtail Supplies

Everything appeared to be working against an adequate supply of petroleum products. In addition to the weather, labor disputes played their part.

In the very midst of the January cold weather, a ten-day strike at the Pan American Refining Corporation's Texas City plant stopped the shipment of 2½ million gallons daily to the East Coast. Strikers received a 12-cent hourly wage increase in addition to the 22-cent hourly cost-of-living increase given by the company.

The Pan American strike was seen as the opening shot in a national campaign for a third round of postwar wage boosts for members of the Oil Workers International Union (CIO). The union's national wage policy committee is to meet February 9. Labor difficulties at this time could play havoc with the industry efforts to furnish enough oil to consumers.

The 296-day strike at The Pure Oil Company's Toledo refinery ended. This plant processes 27,000 barrels daily, hence products from 8 million barrels were lost to the company and consumers while it was idle.

Oil May Be Allocated Larger Amount Of Steel

With the oil shortage at its most critical stage, the question of steel supplies, sorely needed to enable the oil industry to carry out its plans for enlarging the petroleum facilities of the nation continued very much in the limelight.

Most encouraging development was the prospect that the petroleum industry might receive enlarged quantities of steel as a result of the voluntary allocation plan being worked out between the Department of Commerce and the steel industry. Reports were that oil interests might receive from 10 to 15 percent more steel under the plan than it has been receiving. Unless additional steel is received by the industry, its expansion of producing, transportation and refining facilities will be delayed, dimming prospects that the petroleum shortage can be overcome during the next few years.

Allocation of Casing To Operators Proposed

To stop black markets and hoarding of tubular goods, as well as provide equitable distribution of these products, the Texas Independent Producers and Royalty Owners Association last month proposed that casing, drill pipe and tubing be stockpiled and allocated to operators on a prescribed basis. The association requested steel manufacturers appoint a committee to confer with a committee of oil industry assoociations for the purpose of inaugurating the program.

The association proposed that casing, tubing and drill pipe be shipped by manufacturers to stockpiles in various oil producing districts, and that committees appointed by the different state governors allocate supplies from these stockpiles on the following priority basis:

1. To exploratory (wildcat) tests.
2. To wells required to protect leases expiring within six months.
3. To offset wells under contractual obligations.
4. To the first tests on any leases.
5. Then to all other wells.

The association said the plan, in addition to stopping the black markets and eliminating hoarding, would increase crude reserves and make more crude available for consumption if allocated on the above basis.

Tubular Goods Needed Have Increased Sharply

The industry's acute need for larger quantities of steel was pointed out in a study made public during the month by IPAA. The study, based on the relationship of several factors, showed that the industry needed considerably more steel than it has been receiving.

Minimum requirements for casing, tubing and drill pipe in the U. S., according to the study, would amount to 1,245,000 tons during 1948, increase to 1,270,000 tons in 1949; to 1,300,000 tons in 1950; and rise to 1,325,000 tons by 1951.

The supply of these new materials equalled approximately 1 million tons in 1946, and about the same as in prewar normal years, and therefore the needs for the minimum drilling program outlined by the IPAA was 24 percent larger in 1948 than in 1946 and 32 percent greater by 1951.

The above program, it was said, would not correct wartime drilling deficiencies and rebuild oil reserves. Normal requirements, needed to correct wartime drilling deficits and rebuild oil reserves, were estimated by the IPAA at 1,450,000 tons in 1948; at 1,475,000 tons in 1949; at 1,505,000 tons in 1950; and at 1,530,000 tons in 1951.

Thus the amount of tubular goods actually needed by the industry during the next four years would be approximately 50 percent greater than the industry received in 1946.

Showdown Forming On Tidelands Ownership

Lines were formed last month for what should be the final showdown on the question of state or federal government ownership of tidelands.

The stage was set when a measure specifically providing for state ownership of all tidelands and offshore natural resources was introduced in the Senate and the Houses of Representatives. The bill differs from the measure vetoed by President Truman in 1946 by providing that the federal government is to retain all powers of regulation over commerce and navigation, and by giving the federal government the right to take over in time of war.

The new measure has very strong backing, which it will need to override a probable presidential veto. It was drafted after weeks of deliberation by a committee representing the National Association of State Attorneys General, following its endorsement by attorneys general of 44 states. When introduced into the Senate it carried the signatures of 20 senators.

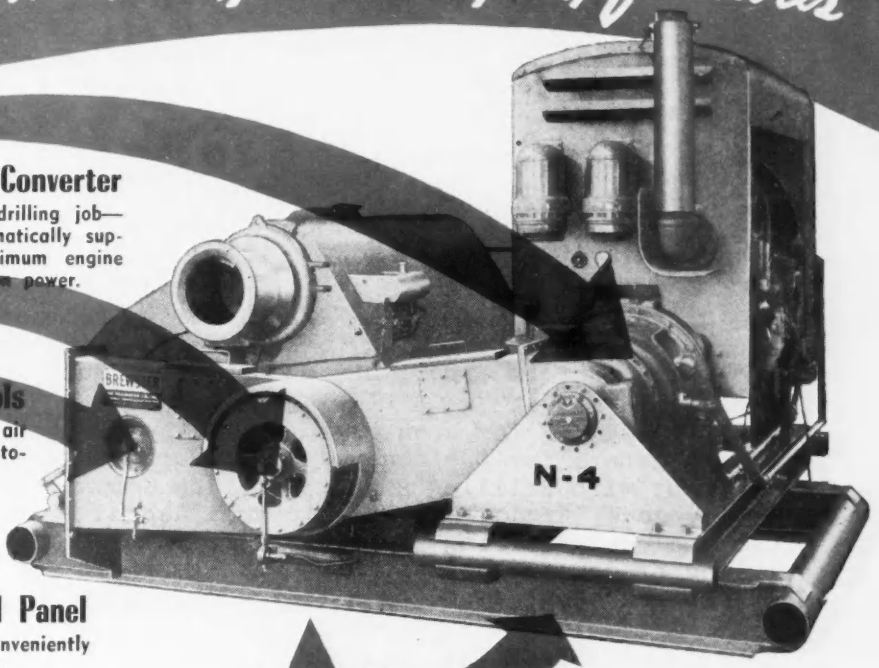
Biggest Field Since East Texas Found?

In the midst of much concern regarding the future supply of petroleum in the U. S. came one highly encouraging and singificant development—the discovery of a new oil field which received exceptionally high rating from some observers. Opinions ranged from the greatest since the opening of the East Texas field in 1930, to the best Texas discovery of the year, down to the more conservative who said additional wells would have to be drilled before any value could be placed upon the strike.

The well, Plymouth Oil Company and Slick-Urschel Oil Company's Alford 1, located in the extreme eastern part of Upton County, West Texas, was completed at 12,022 feet in the Ellenburger dolomite after penerating that formation over 1000 feet. The Texas Railroad Commission assigned the well a daily allowable of 500 barrels, the largest production permitted by that body since controls were initiated.

Colonel E. O. Thompson, chairman of the Texas Commission, described the well as the greatest Texas discovery of the year and possibly the greatest since the finding of the huge East Texas field 17 years ago.

The N-4, a Small Rig with Big Rig features



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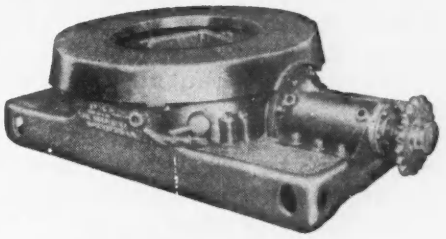

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Looking Ahead

WORLD OIL'S Yearbook Forecast Issue, coming February 15, will give good idea what volume of drilling to expect for 1948. Forecast for 1947 was only 1.5 percent in error, having been that much low.

THE ARGENTINE YPF may soon be entertaining proposals from American drilling contractors for field development work to supplement wildcat program worked out with Drilling and Exploration Company. With rejection of McCarthy deal, Argentina will probably depend on contractors. Terms would include requiring contractors to furnish rigs, tubular goods and drilling crews with payment on a footage basis plus fixed sum for rig depreciation. Rigs would pass to YPF ownership on completion of contracts.

A GASOLINE SHORTAGE will confront the industry next summer. Increased production of heating oils, now forced upon the industry by current critical shortage, can be accomplished only by curtailing output of motor fuels. (See page 21.)

A BIG SYNTHETIC liquid fuels industry in the U. S. is still a long way off, despite intense hopes of government officials prompted by present shortage. Too much investment would be required. (See page 22.)

A CAMPAIGN for a third round of postwar wage boosts by the Oil Workers International Union (CIO) is to be expected. The recent strike at Pan American's Texas City refinery, settled for a 12 cents per hour increase, was the opening shot. The union's national wage policy committee meets February 9. Watch for developments thereafter.

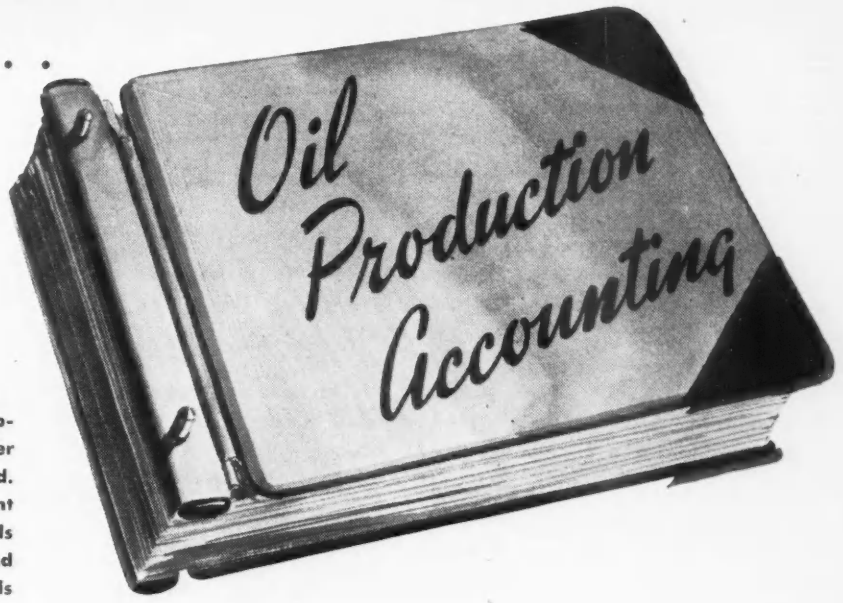
ANOTHER INCREASE in crude oil prices is likely. Recent sharp boosts have failed to check the payment of premiums above posted prices. There is increasing evidence that producers are currently selling larger quantities to premium payers, and this situation again will bring on a general crude price boost.

HOPES OF the oil industry for getting larger quantities of steel have been raised by recent developments. The petroleum shortage has focused attention on the industry's need. Plan for voluntary allocation of steel, being worked out by government and steel representatives, is reported to be considering 15 percent more steel for oil. This will enable industry to speed up its expansion program.

MICRORADIOGRAPHY, a technique in which X-rays are directed through a very thin specimen onto a fine-grained photographic film and the image thus secured is magnified for inspection, is expected to aid materially in the development of steels to meet the severe requirements of three-mile and deeper drilling.

AT LEAST two major passenger cars with compression ratios of 7.75 to 1 and requiring fuel of 88 research octane number gasoline will be on the market next fall, predicts R. J. S. Pigott, chief engineer of Gulf Research and Development Corporation. New engines of an even higher compression ratio have been discussed, but would have required gasoline of 92 to 93 research octane number. This would have pressed the oil companies called upon to supply them at a time when supplies are already short.

PAYMENTS OUT OF OIL and FREE WELLS IN . . .



OIL PRODUCERS are concerned frequently with problems arising from the variety of agreements under which oil properties are purchased, sold or developed. Provisions of many of these agreements present questions pertaining to payments out of oil, free wells or carried interests. Accounting for costs incurred and revenues received under such agreements often calls for special treatment to provide correct financial information and to comply with federal and state income tax laws and regulations.

By ROBERT M. PITCHER

SALES of oil-producing properties are made frequently under agreements that provide for payment of a part of the sale price in cash, the remaining part to be paid out of a percentage of the oil and gas, "as, if, and when produced and sold." Agreements covering this kind of sale will contain varying terms with reference to the payments out of oil. The oil producer must study each agreement and plan the accounting procedure to conform to its specific provisions.

A decision of the U. S. Supreme Court rendered June 1, 1937, known as the "Perkins Decision," applies to the method of accounting for income from a payment out of oil in arriving at taxable income. This decision holds in effect that the proceeds from a percentage of oil and gas payable to the owner of a payment out of oil are to be treated as income to the owner of that payment, and that they do not constitute income to the owner of the producing property. Calculation of taxable income where a payment out of oil is a feature of the accounting must be made in accordance with the provisions of this decision.

The following typical problem is presented to illustrate the basic principles to be applied in the sale and purchase of an oil producing property subject to a payment out of oil. No attempt is made to include any of the varying complicated provisions that are found occasionally in agreements of this nature, since that is obviously impracticable.

"A" Company sells to "B" Company the full working interest in an oil producing property known as the Dale Lease, for a price of $60,000. An amount of $35,000 is to be paid in cash; the balance of $25,000 is to be paid out of one-fourth of seven-eighths of the oil and gas "as, if, and when produced and sold," from the lease. The costs of the Dale Lease to the "A" Company as reflected in their accounts are:

Leasehold	$12,000
Development	48,000
Equipment	65,000
Reserve for Depletion	5,000
Reserve for Development Costs	48,000
Reserve for Depreciation	32,000

"A" Company sets up these entries to record the sale of the property and to adjust the reserve accounts:

Debit Accounts Receivable (current)	$35,000
Contingent Accounts Receivable	25,000
Credit Sale of Capital Assets	60,000
Debit Reserve for Depletion	$ 5,000
Reserve for Development Costs	48,000
Reserve for Depreciation	32,000
Sale of Capital Assets	60,000
Credit Producing Properties (Dale Lease)	125,000
Leasehold	$12,000
Development	48,000
Equipment	65,000
Deferred Earnings from Property Sales	20,000

No current profit has been realized from the sale since the amount of the cash payment is less than the residual costs of the property.

Cost of property	$125,000
Less reserves	85,000
Residual cost	40,000
Cash receivable	35,000
Amount to be received from payment out of oil before any profit is realized	5,000

If production from the lease should terminate before $5000 has been paid on the oil payment, "A" Company will sustain a net loss of the unpaid portion of the $5000. After $5000 has been applied on the payment out of oil, any remaining amounts that are so applied become realized earnings.

Assuming that an amount of $1500 is paid for each of the first four months on the oil payment, the accounting entries will be—

First, second, and third months:	
Debit Cash (or Accounts Receivable)	$1,500
Credit Contingent Accounts Receivable	1,500
Fourth month:	
Debit Cash (or Accounts Receivable)	1,500

Credit Contingent Accounts Receivable 1,500

Debit Deferred Earnings from Property Sales.....$ 500
Credit Sales of Capital Assets (or other income account) 500

An amount of $500 has now been realized in excess of the residual costs of the Dale Lease. It is taken up as current income and the Deferred Earnings account is adjusted. As further amounts are applied on the oil payment from month to month, they are treated as current income with an adjustment of the Deferred Earnings account. If the production and sale of oil and gas from the property should cease before the amount of $25,000 is fully paid on the oil payment, the remaining balances in the Contingent Accounts Receivable and the Deferred Earnings accounts are offset against each other and closed out.

"B" Company acquires the full working interest in the Dale Lease under the agreement; it receives payment for three-fourths of seven-eighths of the oil and gas produced and sold. The remaining one-fourth of seven-eighths of the proceeds from oil and gas sales is paid to "A" Company to apply on the $25,000 payment out of oil. Pursuant to the Perkins Decision which has been referred to in a previous paragraph, the amounts applied on the payment out of oil constitute taxable income to "A" Company.

Two Procedures

"B" Company can adopt either of two procedures in setting up the accounting entries for the purchase of the Dale Lease, and for recording the proceeds from production and sale of oil and gas from the property. Under one procedure the purchase price of the property is set up as follows, assuming that the equipment is inventoried at a condition value of $33,000:

Debit Producing Properties
(Dale Lease) $35,000
Leasehold .....$ 2,000
Equipment 33,000
Credit Accounts Payable
(or Cash) 35,000

A memorandum account will be carried for the payment out of oil to which amounts applied to that payment will be posted. No liability account is set up in the balance sheet accounts for the amount of the payment out of oil. "B" Company will include as income from the property only three-fourths of seven-eighths of the proceeds from production and sale of oil and gas from the property until the payment of oil is fully liquidated. The net income from the property under this procedure will be the same for both financial and income tax purposes, since it conforms to the provisions of the Perkins Decision.

The other accounting procedure that "B" Company can adopt is based on the reasoning that the company has acquired the full working interest in the property and has assumed an obligation, even though contingent, in part payment of the purchase price. That obligation is to be paid from the proceeds from sales of a portion of the oil and gas represented by the working interest. Following this line of reasoning "B" Company will set up these entries for the purchase of the property:

Debit Producing Properties
(Dale Lease) $35,000
Leasehold .....$ 2,000
Equipment 33,000
Contingent Payment from Oil 25,000
Credit Accounts Payable
(or Cash) 35,000
Contingent Accounts Payable 25,000

Assuming that the production and sale of oil for the first month after acquiring the Dale property amounts to $6,000 for the working interest, the accounting entries will be:

Debit Accounts Receivable (purchaser of oil) ¾ of $6000 .....$ 4,500
Producing Properties (Dale Lease) Leasehold (from oil payment) 1,500
Credit Crude Oil Produced (Income) 6,000

Another voucher will be prepared to adjust the contingent accounts for the amount applied on the oil payment.

Debit Contingent Accounts Payable $1,500
Credit Contingent Payment from Oil 1,500

The result of this method of procedure is that "B" Company includes as income the full working interest of seven-eighths of the oil and gas produced and sold. The amounts applied on the payment out of oil are added to the leasehold cost of the property. In computing taxable income "B" Company reports only the proportion of oil and gas production that is free from the payment out of oil. As a basis for cost depletion in reporting taxable income the company can use only the proportion of the cash payment of $35,000 that was allocated to leasehold cost ($2000 as shown in the previous voucher entries).

Carried Interest

Another type of deal made frequently among oil producers is on a basis similar to the following: "C" Oil Company assigns to "D" Oil Company a one-half working interest in an undeveloped lease known as the Draw Lease. As the consideration for the assignment of the half interest "D" Company agrees to drill one well to a specified depth, and to furnish necessary equipment for operating the well, including tankage and flow lines, if the well is found to be commercially productive. "D" Company is to advance all costs of drilling, equipment, and operation, and is to be allowed to recover one-half of such costs from one-half of seven-eighths of the oil and gas produced and sold from the property. When and if one-half of the proceeds

Producing Properties Ledger Form

Investment costs pertaining to developed oil properties are assembled and classified in an auxiliary ledger known under such a descriptive title as Farm Investment, Producing Properties, Operated Properties, etc. The form illustrated below is presented as a type of the auxiliary ledger sheet used by many operators. If greater detail of classification is desired an insert sheet can be used to provide additional columns. The form as illustrated can be set up on sheets of standard size, 12 by 19 inches.

PRODUCING PROPERTIES LEDGER

Date	Vchr. No.	ITEM	Well No.	Total	Lease-hold Cost	Development and Equipm't Cost	INTANGIBLE COSTS							TANGIBLE		
							Drilling	Labor	Hauling	Cementing Casing	SUNDRY Item	SUNDRY Amount	Total Intang. Cost	Derricks and Rigs	Engines	Treating Plant

from one-half of the oil and gas sales have been sufficient to repay "D" Company for one-half of costs advanced under the agreement, "C" Company is to become the owner of an undivided one-half interest in the equipment. Payment is thereafter to be made direct to "C" Company for amounts accruing to its one-half working interest in the property from production and sales of oil and gas. After that date "C" Company is to pay its proportion of operating costs and any further development costs in cash as bills are rendered by "D" Company.

Under an agreement similar to the one outlined, "D" Company becomes in effect the full owner of the working interest in well No. 1 on the Draw Lease until certain costs have been returned to it from oil and gas production and sales. During that period "D" Company advances all costs of development, equipment, and operation of the well, and receives all income accruing to the working interest in the well. At the present time certain Circuit Court decisions and rulings of the Federal Internal Revenue Department are not in accord regarding the taxable status of the net income of the working interest under this kind of an agreement. We will therefore present the accounting features arising under the agreement from a sound accounting point of view, recognizing that the procedure may conflict in some respects with present court decisions or Internal Revenue Department rulings.

For example, assume that "D" Company completes a producing well on the Draw Lease at a cost of $12,500 or for development and $14,000 for equipment, these costs having been assembled in a Work in Progress account. Since the completion of a well is the consideration for which "D" Company acquires a half working interest in the lease, one-half of the development costs must be capitalized as leasehold cost. At the date of completion of the well, "D" Company is, in effect, the owner of the entire working interest in the well. This condition will continue until one-half of the development and equipment costs together with one-half of the operating costs of the well have been repaid from one-half of the proceeds from the production and sales of oil and gas. During this interval "D" Company will receive all of the income accruing to the working interest in the well and will include that income with its taxable earnings. The accounting entries for development and equipment will be:

Debit producing Properties		
(Draw Lease)		$26,500
Leasehold	$ 6,250	
Development	6,250	
Equipment	14,000	

A contingent account receivable may be set up to record the amount to be repaid from oil and gas sales for one-half of the development and equipment costs, with a contra account termed "Contingent Payment from Oil and Gas Sales, Draw Lease."

During the period in which "D" Company receives the entire income accruing to the working interest in the well, it obviously will take up the full amount of depletion and depreciation allowable for its operation. If the well should cease production before the contingent obligation of "C" Company has been liquidated by oil and gas sales and from salvage of equipment, the residual costs are chargeable to an account carried for abandoned properties.

In the event that the well pays out, "D" Company must then adjust its Producing Properties and Reserve accounts for the proportion of ownership that passes to "C" Company. "D" Company has included as its income the proceeds from oil and gas sales that served to repay the company for one-half of its costs, and that income has been taken into its Surplus account. It is logical, therefore, to charge to Surplus account one-half of its residual investment costs for the well. Assuming that "D" Company has set up $3750 for depletion of development cost and $8400 for depreciation of equipment, the adjusting entries will be:

Debit Reserve for Depletion of Development Cost		$ 3,750
Reserve for Depreciation		4,200
Surplus		5,300
Credit Producing Properties (Draw Lease)		13,250
Development	$6,250	
Equipment	7,000	

The original amount of equipment cost has been used in the preceding entries, although it is probable that the cost would have changed during the payout interval due to transfers of equipment.

The accounting problem of "C" Company is fairly simple. Up to the time the production from the well has paid out the costs of "D" Company, "C" Company has no actual investment cost in its accounts aside from the amount that was paid for its lease. Since it does not

■ CONTINUED ON PAGE 41

About the Author

ROBERT M. PITCHER of Tulsa has had long experience as an accountant dealing with oil production. He is author of the book, "Practical Accounting for Oil Producers," and has written magazine articles on oil industry accounting, including one in *The Oil Weekly* (now WORLD OIL), June 23, 1947, titled "Depletion and Depreciation in Oil Production Accounting." His writings reflect his experience in an executive capacity, viewing accounting problems from the executive's as well as the accountant's standpoint. In 1939 he began teaching oil production accounting at the University of Tulsa, Downtown Division.

PRODUCING PROPERTIES LEDGER

COSTS

BUILDINGS		TANKS AND SEPARATORS		PUMPING EQUIPMENT		CASING		TUBING		WELL FITTINGS		FLOW LINES		SUNDRY		Total Tangible Costs
Description	Amount	Description	Amount	Description	Amount	Size and Feet	Amount	Size and Feet	Amount	Description	Amount	Description	Amount	Item	Amount	

St. Lawrence Seaway

MAY BECOME VITAL OIL ARTERY

THE U. S. and Canada in the near future may procure such substantial quantities of petroleum from foreign sources that the St. Lawrence Seaway could become a vital link in bringing foreign oil to the Great Lakes area of both countries. This waterway could assume an important role especially in the event of the need for bringing oils from the Middle East into Canada and the U. S. Midwest.

The St. Lawrence River has in the past been a common route for oils coming into Canada from South America. A crude oil pipe line was built during the war period, from Portland, Maine, to refineries at Montreal, to avoid the long tanker haul of Canada-bound South American crudes around the maritime provinces and the mouth of the St. Lawrence. Capacity of this 236-mile 12-inch pipe line is being increased from 71,000 barrels per day on light crude to 81,000 daily by installing a third pumping unit at each of the eight pumping stations of the system. Owners of the line have under study a project for laying a second main line of 20-inch diameter from Portland to Montreal but anticipate that it will not be possible to start construction on that project until 1951, as they have not been able to get a better delivery date on pipe than four years.

Meanwhile, the old all-tanker route for oil shipments from South America to Canada has not been supplanted but merely supplemented by the trans-Maine pipe line system.

About 90 percent of the St. Lawrence Seaway is already complete, and decision on whether to complete it is expected during the second session of the present U. S. Congress. The purpose of the project, which dates back to 1895, is to remove the remaining obstruction to deep water navigation between the Great Lakes and the lower St. Lawrence River, permitting passage of deep water ocean craft from the Atlantic to Great Lakes ports.

In case imports of oil from the Middle East assume great importance for the U. S. and Canada, the St. Lawrence Seaway "would be in a strategic position to distribute the crude to refineries both in the Province of Ontario and the Lakes area of the U. S.," stated Paul M. Zeis in discussing this seaway in a recent report for *Domestic Transportation*, issued by the Bureau of Foreign and Domestic Commerce of the Department of Commerce. "The only other method of transportation that could compete with the Seaway on an economic basis," he said, "would be pipe line."

Transportation Cost

There is little mileage difference, this report points out, whether tankers sail to Montreal or to U. S. Atlantic ports from the Middle East. If oil shipments terminate at Atlantic ports, pipe lines would have to be provided to transport the petroleum to refineries in the Lakes area. "It would seem reasonable," the report concludes, "that large lake tankers could move crude oil via the Seaway at a cost of about 10 cents or 12 cents per ton per day. Estimated time required to reach important Lake ports from Montreal is Buffalo, two days; Erie, 2.2 days; Cleveland, 2.5 days; Toledo, 2.7 days; Detroit, 2.8 days; Chicago, 5 days. Adding one day for loading

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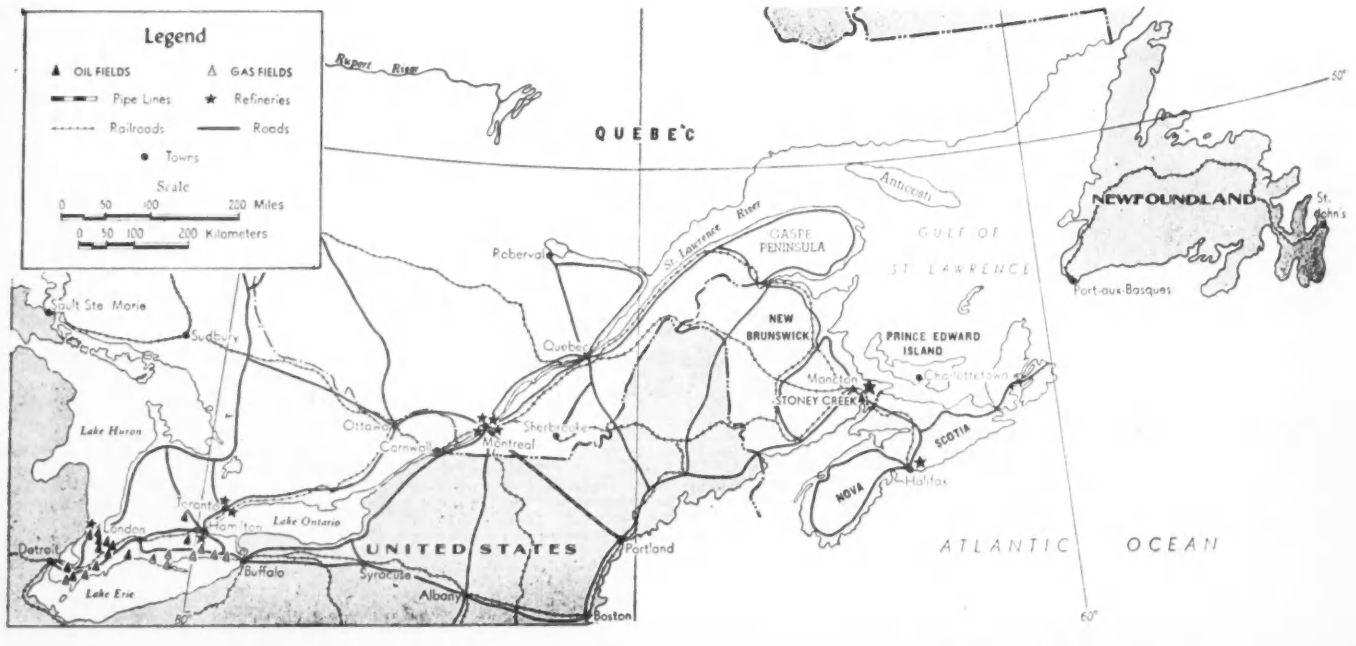

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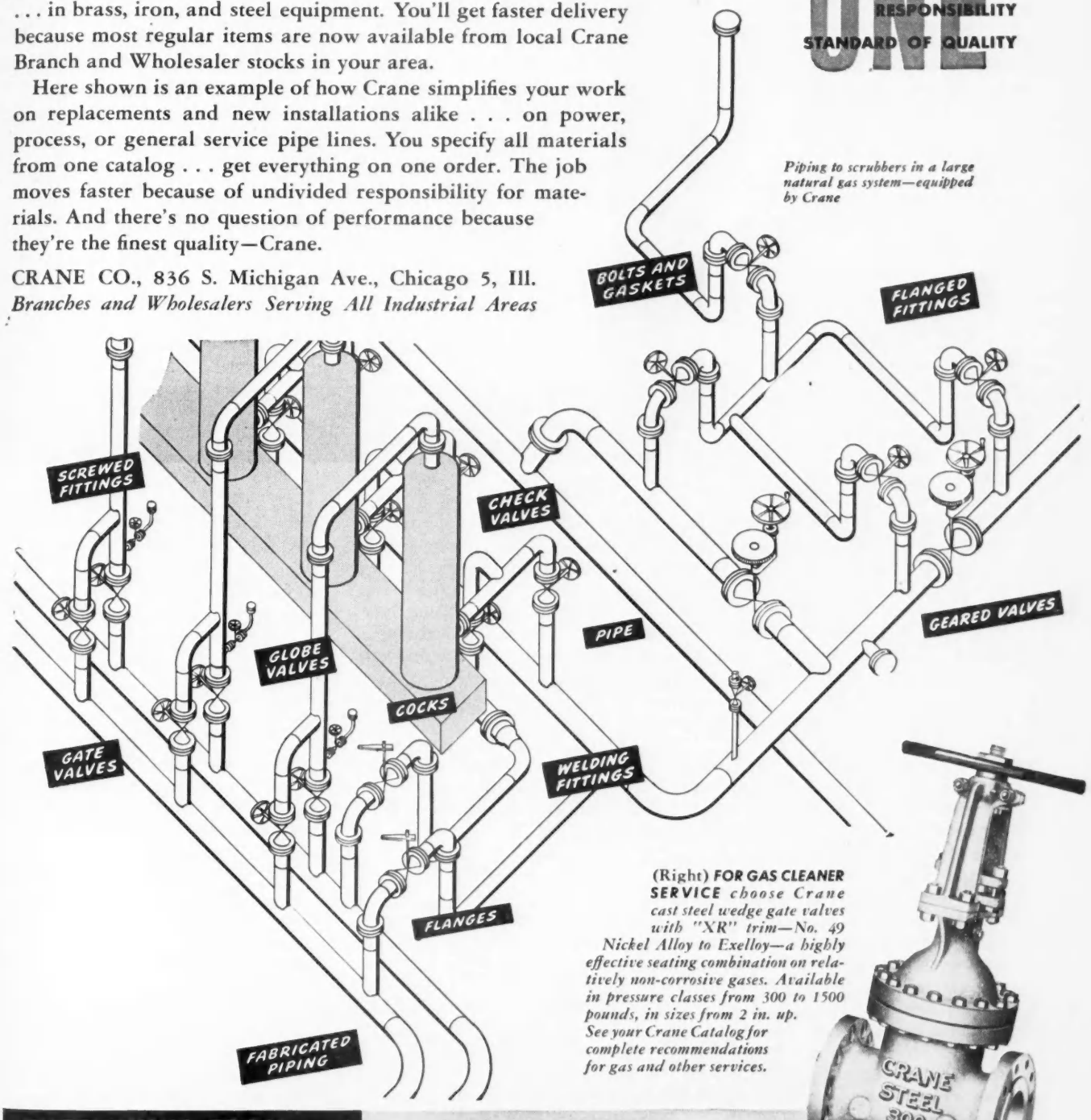

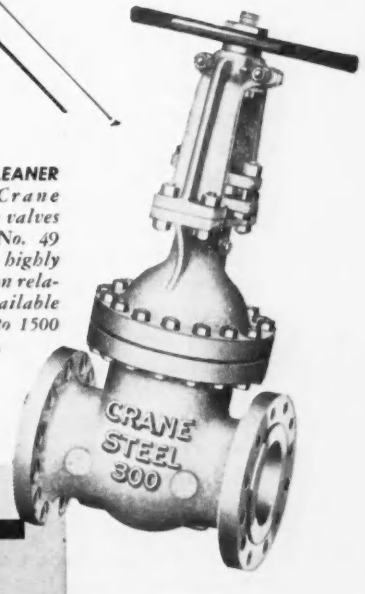

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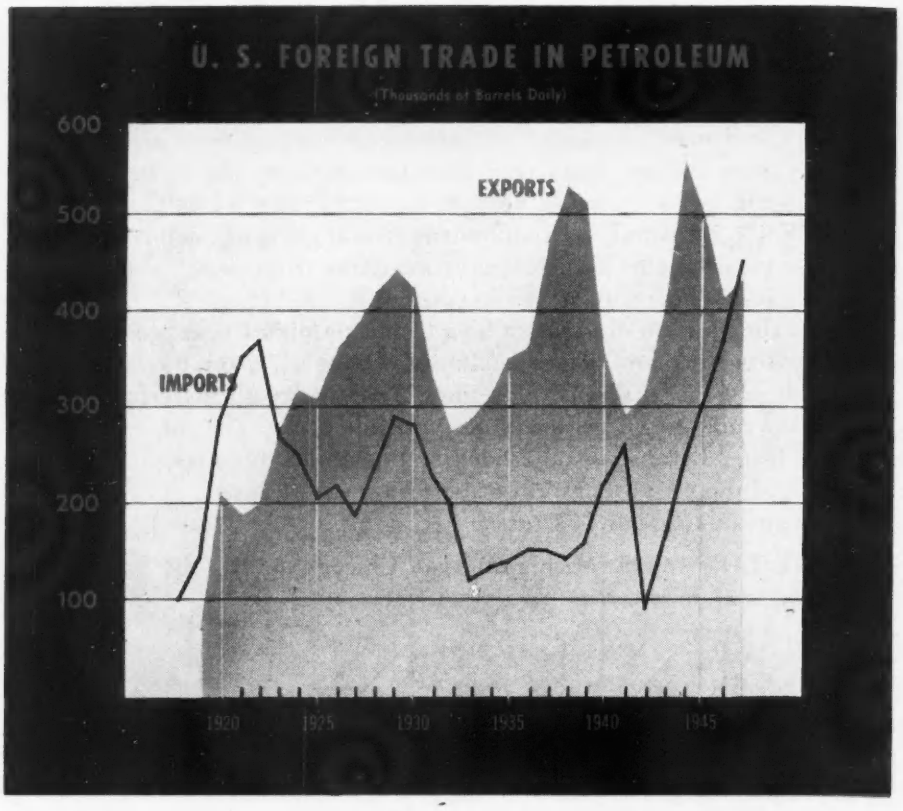

THE year 1948 will mark a revolutionary change in America's international petroleum trade, the first full year in which we shall reverse our historical position as a net exporter and will become a net importer of oil. With sharp reductions in U. S. export trade generally in prospect, due to drastically curtailed dollar purchases by the United Kingdom and France, we are not expected to recover a "favorable trade balance" in world oil commerce.

Britain is slashing her dollar imports at the rate of $900 million a year; France has decreed a savings of $250 million during the next six months; and Australia has cut her imports by $40 million annually. Britain's savings in payments to overseas sellers include one item of $20 million on U. S. gasoline alone.

This reversal of our traditional oil export-import position is in line with indications that the U. S. henceforth may depend on foreign sources for an increased and perhaps considerable proportion of its petroleum requirements. Such a possibility is based on the narrowed ratio between our proved reserves and our rate of oil production, with current discovery rates indicating that production will not be increased in line with prospective gains in oil requirements.

The first six months of 1947 saw 4.3 percent more oil exports from the U. S. than in the first six months of 1946—the half-year total being 81,711,000 barrels of crude and products as against 78,329,000 for the corresponding months of 1946. However, the first half of 1947 recorded the steepest rise in our total export volume of all goods of any comparable period in our history. We passed the $15 billion a year rate. In terms of dollar value this is five times the prewar level and even after adjustments for postwar price increases, it is three times that level. This fact further emphasizes our rapidly declining petroleum exports.

Machinery, as usual, leads the list of export commodities—industrial, electrical and agricultural equipment—with textiles the second largest item of export.

The U. S. has had a $200 million annual export balance in foreign oil trade since 1911, with a record high balance of $821 million in 1944.

At the same time that our oil exports are flattening out or threatening to decline, our oil imports are showing a moderate increase, although imports of crude petroleum and products declined from 14,328,000 barrels during May, 1947, to 11,339,000 barrels for June, 1947, the lowest monthly figure for the year. Thus the daily average import for June was 377,966 barrels compared with an average of 454,563 for the first half of the year.

The June decrease was due to lower receipts of residual oil, chiefly from the Netherlands West Indies. Total imports of 82,276,000 barrels during the first six months of 1947 were 25.9 percent greater than for the same period of 1946.

Danger Signal

To the extent that we anticipate at least partial dependence on foreign crude sources, any decline in oil imports is a danger signal unless counterbalanced by a decrease in exports. And even if such counterbalance is achieved, according to many analysts, the problem is not solved, because paralysis of international commerce, particularly when due to trade barriers, is not considered economically healthy. The current 10½-cent a barrel impost duty on crude petroleum is not generally regarded as gravely curtailing imports, although there has been a recent demand from some suppliers that the duty be cut in half under the executive authority granted by the Reciprocal Trade Act, in order to stimulate oil imports.

More than that, however, inasmuch as the Marshall plan and the tentative charter of the Preparatory Commission of the International Trade Organization at Geneva express our new national policy, U. S. export trade is the chief economic peg on which hangs the hope of European recovery; and there is rather full agreement now that an industrially healthy Europe is a requisite for a sound economic America. We are now placing heavy emphasis on what otherwise would be considered a trivial part of our industrial piechart—for even at its peak, our export trade represents only 6 percent of our gross national product.

As against a total export volume of around $15 billion yearly for the first half of 1947, U. S. total imports ran at about $5 billion annually. The difference between these two figures—roughly $10 billion—is our "favorable balance of trade," which we have discovered is not favorable at all, because it represents the amount of expendable dollars foreign purchasers must get to maintain their level of buying from us. This seems impossible now through any increase of sales to the U. S. Thus, while export trade in a percentage sense is still marginal business for us, in the long run and in terms of our official

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national thinking at the conferences of Paris and Geneva, it has serious implications; a stabilized world economy can breed peace, a demoralized world economy almost certainly will breed war.

The immediate effect of reduction of oil exports might be to relieve gasoline and fuel oil pinches in the U. S., particularly in the Midwest (District 2). This could be expected for a sequence of reasons: export decline would free tankers from Gulf Coast-European runs to intercoastal service and thus would allow greater inflow of product into the upper East Coast area (District 1) for transportation to the Midwest. Practically all exports are now carried from Gulf Coast points, and the resulting shortage of ship bottoms and rail cars for movement from the main producing area (District 3) into the Midwest is partially accountable for the District 2 squeeze. This is merely to say that our current oil "shortage" is chiefly a matter of lack of transportation rather than of production.

However, the Preparatory Commission of the United Nations conference on international trade, meeting in Geneva, closed its sessions with a strong appeal to member nations not to sacrifice the long-run objectives of international cooperation in the struggle to meet temporary problems. The views of the U. S. were prominently recorded at that conference and were embodied in the draft charter presented to another conference of 60 nations at Havana in November, with oil-producing nations represented.

Charter Goal

The goal of the charter is to increase world production, employment, and trade and to foster industrial and economic development and reconstruction, equal access of all countries to markets, and the reduction of tariff preferences and trade encoumbrances. Clair Wilcox, deputy chief of the U. S. delegation at Geneva, said the U. S. could not believe that "we should permit the difficulties of the present to obscure the urgent need for agreement now on policies that are to govern the trade of the world in a better future." He added: "We have given recognition for the first time in an international instrument to the interdependence of national programs for the stabilization of production and international programs for the liberation of trade. We have placed in the forefront of international thinking the need for developing the resources of the less-developed areas of the world. We have proposed that all nations commit themselves in a single document to extend to one another most-favored-nation treatment with respect to custom charges and requirements and national treatment with respect to internal taxation and regulations."

The reduction of tariffs and the abolition of trade discrimination are prime objectives of the charter, according to Wilcox, a position that repeatedly has been voiced by Undersecretary of State William Clayton, who attended both the Geneva conference and the Paris conference on the Marshall plan.

There is one aspect of the business of exports by American oil companies that is attracting increased attention; it is the matter of non-petroleum shipments abroad representing chiefly capital investment in foreign production facilities. All American oil firms reinvest in the various countries in which they operate a substantial portion of their profits in those countries. From 1935 to 1944 a total of 11 American oil companies spent a combined average of $33 million a year on supplies and equipment for shipment abroad. Now, since foreign production is certain to increase greatly, huge new investments will be required in the form of U. S. supplies and equipment for the various branches of the industry. While hundreds of millions of dollars and enormous amounts of steel products and other goods are being expended on new foreign pipe lines and production facilities, foreign refining capacity currently is being expanded by one third

From 1918 to 1944 a total investment of $3200 million had been made by 11 American oil companies in oil operations abroad, of which $1300 million was for exploration and production. In a number of instances, as much as $50 million to $100 million was invested before the first barrel of oil was produced commercially. Such figures give some idea of the tremendous investment that may be ahead in Middle East development by companies like Arabian American Oil Company or the American-Independent Oil Company, and suggest that such activity will involve gigantic volumes of non-petroleum exports by the companies.

U. S. Oil Exports and Imports
(In thousands of barrels)

YEAR	Imports of Crude and Product	Exports of Crude and Product	PERCENT OF TOTAL SUPPLY	
			Imported	Exported
Average:				
1901-1910	295	29,777	0.2	21.6
1911-1920	31,802	59,093	9.3	17.4
1921-1930	89,614	122,713	10.0	13.7
1931-1940	62,048	139,587	5.3	11.9
1941-1945	80,479	153,518	4.8	9.1
1941	97,142	108,830	6.2	7.0
1942	35,966	116,907	2.4	7.9
1943	63,412	149,957	3.9	9.2
1944	92,256	208,911	5.0	11.3
1945	113,619	182,983	6.0	9.6
1946	135,033	151,204	6.9	7.8
1947 (Latter Half Est.)	157,000	163,000	7.4	7.6
1948 (Forecast)	166,800	149,000	7.5	6.7

St. Lawrence Seaway

■ CONTINUED FROM PAGE 34

and unloading, the cost of transporting a ton of petroleum from Montreal via the Seaway to Cleveland would be about 60-74 cents, and to Chicago about $1.10-1.32, including time for round trip. Thus it is apparent that only in very large pipe lines can oil be transported as economically as by tanker.

"Including toll charges the cost of transporting crude oil through the St. Lawrence Seaway to Chicago and other ports on Lower Lake Michigan might be slightly more expensive than the cost of transport from the Atlantic Coast through large pipe lines of the Big Inch kind. To ports at the head of the Lakes, tanker transportation almost certainly would be cheaper."

In considering the potential petroleum traffic on the St. Lawrence Seaway, pertinent information is given by examining the present flow of petroleum into the Great Lakes area. More than 70 percent of the total amount of crude oil received by Canadian refineries during 1945 was received by refineries located in the Maritime Provinces and Quebec and Ontario. Of particular interest is the fact that, except for 113,086 barrels received from the Ontario fields, all the crude in these important refining provinces originated from sources outside Canada.

In the case of the Maritimes and Quebec, stated the Zeis report, most of the imports were from South America with 7,518,392 barrels originating in Colombia and 15,923,157 barrels originating in Venezuela. A relatively small quantity (only 571,365 barrels) originated in Texas. Part of this traffic goes directly to Montreal by tanker and part goes to Portland, Maine, and is then transshipped by pipe line to Montreal.

Ontario, on the other hand, the report points out, receives all its imports of crude from the U. S. Of these imports, totalling 22,637,559 barrels, over half comes from Illinois. The remaining imports originate chiefly in the Mid-Continent and Texas areas.

The largest refineries in the Province of Ontario are at Toronto and Sarnia. Both of these are on the Lakes and thus have access to water transportation. Also, a pipe line connects Sarnia with pipe lines terminating in Ohio. Crude can move by pipe line from Toledo and from there by tanker to Toronto. During 1945 a total of 1,923,498 short tons of crude petroleum was exported from Toledo to Canada. This was equivalent to more than half of Ontario's total imports of crude for that year.

Potential Traffic

In the event that U. S. petroleum supplies become inadequate to meet the growing domestic demand and the needs

of the Ontario refineries, Zeis believes, it is likely that these refineries will draw more heavily on overseas sources. With the development of the Seaway, it is probable that Ontario imports of crude from the Caribbean and other overseas sources will constitute potential traffic on the Seaway. Such traffic, Zeis believes, might range from 1.5 million barrels in the immediate future to more than 20 million barrels as a possible long-range movement.

There has developed a movement of gasoline and other products on the existing St. Lawrence Canals. This traffic totalled about a million tons from 1938 to 1942. Zeis observes: "This would be a minimum which would be expected to be moved on completion of the Seaway. The volume of petroleum traffic which might be expected to move into the U. S. Lakes area via the Seaway is dependent on two important factors: (1) the extent to which present reserves in the Mid-Continent area will be sufficient to maintain the present traffic problem, and (2) if we increase our dependence on foreign imports, will shipments via the Seaway into the Lakes area be as economical as pipe line shipments?"

Oil Production Accounting

■ CONTINUED FROM PAGE 33

receive any income from the well, and does not acquire any actual ownership of it during the payout interval, it is logical to contend that it does not have any taxable earning with reference to it. If the well fails to pay out, "C" Company will receive no returns from it and its original lease cost becomes a definite loss. Following the assumption in a previous paragraph that the well pays out, "C" Company becomes the owner of an undivided half interest in it and begins to receive income from its production. The company acquires that ownership as the result of the payment to "D" Company of an amount of money accruing to "C" Company's working interest which it retained in the assignment to "D" Company. "C" Company, therefore, sets up in its accounts the condition value of one-half of the equipment and an amount representing one-half of the development costs. The total amount so set up is credited to Surplus account since it was paid for out of the value of one-half of the oil and gas produced and sold from the well.

Free Wells

Typical "free-well" agreements provide that the assignee of a fractional working interest in an oil lease will drill and equip one or more wells on the lease without cost to the assignor. Under this type of an agreement the assignor acquires ownership of an individed fractional interest in the well equipment immediately on the completion of any productive wells required by the agreement. The assignor also receives, commencing from the date of first production, the portion of proceeds from the production and sale of oil and gas that accrues to the percentage of ownership he has retained in the property. The party who operates the property advances the operating costs and bills the non-operating owner with his proportion of those costs.

The accounting features arising from a free-well agreement can be exemplified from the following hypothesis: "E" Oil Company assigns "F" Oil Company a three-fourths working interest in its Tray Lease. "F" Company agrees to drill one well to a specified depth and to assume all costs of development and necessary equipment. "E" Company is to have ownership of an individed one-fourth interest in the equipment if the well is completed as a producer, and is to receive the proceeds from the production and sale of one-fourth of the oil and gas accruing to the working interest from the date of first production. The well is to be operated by "F" Company which will render a bill each month to "E" Company for one-fourth of the operating costs. The bills for operating costs are subject to prompt payment by "E" Company. A productive well is completed on the Tray Lease by "F" Company in accordance with the agreement at a cost of $12,400 for development and $10,000 for equipment.

Since the drilling and equipment cost of one well is the consideration for which "F" Company acquired its interest in the Tray Lease, that company capitalizes as leasehold cost the proportion of costs represented by the one-fourth interest that passes to "E" Company according to the terms of the agreement. The voucher entries are:

Debit Producing Properties	
(Tray Lease)	$22,400
Leasehold	$5,600
Development	9,300
Equipment	7,500
Credit Wells in Progress	$22,400

The item of $9300 for development costs (¾ of $12,400) is either expensed or capitalized for financial and tax purposes, depending on the practice that is followed by "F" Company in that respect.

"E" Company may adopt any one of three methods of procedure in setting up its accounts for the well that has been completed on the Tray Lease. The only cost sustained by "E" Company is the amount paid for the lease minus any amortization that may have been set up against it. Assuming that the cost of the lease is $2000 and that no amortization has been set up, one of the following entries can be made:

1. A nominal amount can be assigned as equipment cost, with the balance of the lease cost charged to leasehold cost; for example—

Debit Producing Properties	
(Tray Lease)	$2,000
Leasehold	$1,975
Equipment (Free Well)	25
Credit Undeveloped Leases	2,000

Pursuant to this procedure there is no equipment cost on which depreciation can be taken; a transfer of any of the free-well equipment will reflect an earning for the full amount of one-fourth of the transfer value.

2. The management of "E" Company may reason that a three-fourths working interest in the Tray Lease has been exchanged for an undivided interest in a quantity of equipment. The voucher entries conforming to this reasoning are

Debit Producing Properties	
(Tray Lease)	$2,000
Leasehold	$ 500
Equipment (Free Well)	1,500
Credit undeveloped Leases	2,000

The effect of this voucher is to carry into the equipment section of the Producing Properties account for the Tray Lease an amount representing the cost of the asset that was exchanged for the interest acquired in the equipment. There is an equipment value on which depreciation can be taken.

3. The theory might be advanced that "E" Company has sold to "F" Company a three-fourths interest in the Tray Lease, and has received in payment an asset worth $2500 represented by a one-fourth individed interest in equipment that has a cost value of $10,000. If this theory is adopted, the voucher entries will be

Debit Producing Properties	
(Tray Lease)	$3,250
Leasehold	$ 750
Equipment	2,500
Credit Undeveloped Leases	2,000
Sale of Capital Assets	1,250

This method brings into the accounts a profit of $1250 that has not been realized. The profit may never be fully realized, since it can only be earned through disposal of the equipment by sale or transfer at a value in excess of the amount of $2500 minus whatever depreciation may have been taken.

This is a violation of sound accounting since it brings into the profit and loss result an unrealized earning.

BRITAIN'S COAL INDUSTRY

CAN BRITAIN rehabilitate her coal industry under her five-year nationalization project? What is the likely competitive balance between coal and oil in Britain? What is the probable effect on both American and Empire trade of the British plan to rebuild coal as the key factor in England's national economy? These questions are of increasing significance to American industrial—including petroleum—economists. This article deals with some of the more crucial and immediate aspects of the problem in an effort to reach an overall evaluation of the British fuel program.

By HENRY OZANNE
Staff Writer

THE British treasury plans to spend $600 million in the next five years to develop the nation's coal industry, and is prepared to lend another $40 million to the National Coal Board, the industry administrator.

At the same time Britain is studying closely what economies can be made by converting her industries to oil, especially in connection with whatever assistance she may receive from the $2460 million petroleum aid, including 860 million barrels of oil, projected for the Marshall Plan nations. Last October the Minister of Fuel and Power told the House of Commons that Britain had hoped to save 3 million tons of coal for that coal year, but actually might not save more than 1 million tons through conversion to oil. However, for the present coal year, ending April, 1948, the goal has been set to save 5 million tons of coal by conversion to oil. High priority has been given materials needed to convert engines and plants.

Britain's coal crisis has a long background, the essential features of which must be grasped to understand her present plight. Ample, low-cost coal was the key factor in British industrial leadership of the 19th century. Even as late as the beginning of World War I, in 1914, Britain employed 1,127,000 men in her coal industry and was producing 287 million tons a year, of which 98 million were exported. After that war Britain's coal industry deteriorated markedly. Cost rose sharply because of the exhaustion of the more easily accessible seams and of increased wages which were not matched by corresponding increases in production per man. Then, too, there was a rapid drop in demand because of economies effected in both industrial and private use, and because of the decline in exports. Production fell to 208 million tons in 1933 and had risen to only 226 million by 1938 with only 782,000 men employed in the industry. During World War II it proved impossible to reverse the falling trend in production, since the mines had not been developed properly during the preceding ten years.

Industry Nationalized

This situation explains Britain's decision to nationalize. As early as 1919 the chairman of a royal commission investigating coal had proposed nationalization of the mines. During World War II the British government exercised greater and greater control over the industry, and in June, 1942, the Ministry of Fuel and Power was created and empowered to take operational control. Still unsolved were the basic problems: increase of production per man, high average age of workers in the pits, low productivity of the seams, substandard wage scales, etc.

Nationalization had been written in the Labor Party's program for years, and was highly stressed when that party came to power in July, 1945. The bill to nationalize was introduced that December, and became a law July 12, 1946, providing for nationalization beginning January 1, 1947.

A nine-man National Coal Board, appointed by the Minister of Fuel and Power, now conducts the whole industry. The Board's program is aimed at thoroughly reorganizing the coal industry to attain an annual production of 250 million tons by 1951. It is generally conceded that coal is the most important item to British manufacturing industries on which Britain's domestic recovery and exports depend. In fact, the Board plans to make coal the country's most valuable export in order to bridge the gap between imports and exports. According to her Marshall Plan report, Britain plans to resume exports of coal to Western Europe by April, 1948, raising such exports from 6 million tons at that date to 29 million tons in 1951.

To promote this program orders have been placed for coal-face machinery

British Coal: Weekly Figures

	Total Output (Weekly Average in Thousands of Tons)	Manpower	Distributed Stocks (In Thousands of Tons)	Absenteeism Percentage (Overall)	Overall Output in Tons per manshift
1938	4,353	782,000	.....	6.44	1.14
1946	3,646	697,000	8,466	15.95	1.03
1947:					
January	3,707	694,000	6,653	16.69	1.06
April	3,672	710,000	6,017	14.46	1.03
May	3,794	715,000	7,941	9.77	1.08
June	3,851	717,000	10,544	9.78	1.08
July	3,332	719,000	11,985	10.53	1.06
Week Ended:					
September 6	3,638	717,600	13,149	11.24	1.05
September 13	3,581	717,100	13,496	11.71	1.05
September 20	3,875	716,000	13,919	10.76	1.08
September 27	3,892	716,000	14,333	....	....
October 4	3,902	.....	.....	....	....
October 11	4,017	.....	.....	.....	.....

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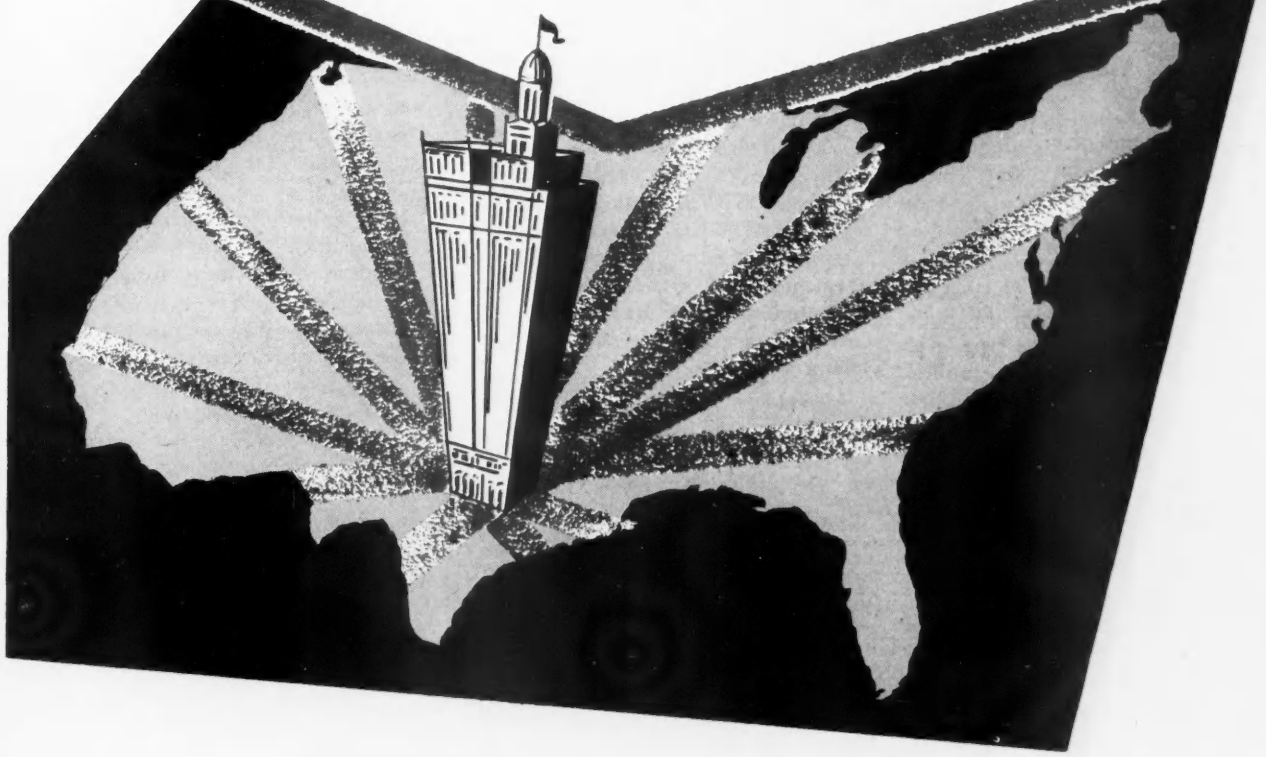

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MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

British Coal Statistics: Annual Production and Consumption
(IN MILLION TONS)

YEAR	Production	CONSUMPTION		Insured Workers in Industry
		Inland	Overseas Shipments and Bunkers	
1913	287	193	94	1,107,000
1929	258	181	77	1,075,000
1933	207	154	53	1,024,000
1938	227	181	46	858,000
1939	231	184.5	46.5	766,000
1940	223	196.4	26.6	749,000
1941	206	196.9	9.1	698,000
1942	204	196.7	7.3	709,000
1943	198	190.7	7.3	708,000
1944	190.8	184.7	6.1	710,000
1945	182.3	174.1	8.2	709,000
1946	188.9	180.2	8.7	697,000

alone to the value of $36 million. Short-term development plans, each costing from $800,000 to $1,200,000, are receiving priority. In addition 20 long-term development plans, each costing up to $12 million and requiring six years to complete, will be in hand by the end of 1948, while ten more will be undertaken annually during the following eight years, making a total of 100 long-term projects.

Now, what about British coal production, present and expected? The output target for 1947 is 199 million tons; for 1948 it is 214 million tons. The 1950 level of 250 million tons would be 18 million tons above 1938 production. So much for the goals.

Actually, Britain bids fair to attain these figures. With an output of 4,017,100 tons during the second week in October (last available record), the mines have achieved their highest weekly production since May of this year. In the first eight months of 1947, British coal production exceeded the output for the similar period of 1946 by 4,244,100 tons. Reserve stocks of 14,333,000 tons were 40 percent higher than a year ago.

Further, this latest production figure is 117,100 tons above the weekly minimum output which Hugh Gaitskell, Minister of Fuel and Power, said the miners must produce from November to May to keep pace with coal requirements. More significantly, output per worker is increasing. By 1945 production per man had dropped to one ton per shift from 1.14 tons per man per shift in 1938. But by April, 1946, output per man-shift at the coal face was 2.73 tons and by April, 1947, it had reached 2.77 tons. It reached a high of 2.88 tons in May, 1947.

More Labor

There is also no doubt that Britain is succeeding to a large extent in recruiting men back to work in the mines. During World War II many miners left the pits for the armed services and for other higher-paying industrial jobs. The pre-war normal industry personnel of more than 1 million had shrunk to 782,000 in 1938 and continued to fall throughout the war, and after, until by 1946 only 697,000 miners were at work in Britain. A key aim of the recovery program is to attract men back to the mines, and a minimum of 730,000 is needed by the end of this year. Improved working conditions and better wage scales have been instituted and the British industry is now gaining workers at the rate of about 4500 a month.

Absenteeism, a critical problem, which was 6.4 percent in 1938, rose to 19 percent in January, 1946. It them began to drop off, falling to 14.5 percent in April, 1947, and to 9.8 percent in May, 1947.

Yet it is certain that stimulated recruiting cannot alone assure the required future production levels. Increased mechanization and the development of richer pits are needed. But here is an extremely difficult situation, the British mines, it is so often forgotten, are considerably mechanized already within present possible limits. Of all coal produced in British mines, 72 percent is now cut mechanically and 69 percent is mechanically conveyed. Mechanical loading, however, is not generally used. Further mechanization is not too promising because of conditions in the British mines so different from those in the American mines. In Britain the narrowness of the seams and the whole pattern of working the coal prevent adoption of the mechanical aids that have helped increase American output. Further mechanization of the Brtish mines must encompass entire new layouts, including the sinking of new shafts and entries.

Rightly or wrongly, the British people of all political parties are now generally agreed that nationalization is necessary for the continuance of the coal industry. One of the great advantages of nationalization, it is argued, is the flexibility afforded to concentrate operations in the most productive mines and shut the less productive ones. Highly varied mining conditions prevail in Britain and the five-year program contemplates intensifying operations in the more productive areas. The Coal Board also points out that the 1947 winter coal crisis was not due to nationalization but solely to weather conditions, the most severe winter for Britain since 1894. Actually, the crisis occurred at a time of rising output which the government takes as evidence of satisfaction of the miners at the achievement of nationalization.

In summary, the short-term prospects for the British coal industry are not assured, but the long-term look is much more encouraging. Britain still possesses huge coal reserves, and during the last ten months, at least, her industry has taken real strides forward. The five-year plan for a 250-million-ton annual output is thoroughly possible and should be realized, and if it is realized the cost expended on it will not be excessive.

Coal Exports from Great Britain
(IN THOUSAND TONS)

	1938	1945	1946
Total Exports	35,856	3,325	4,454
Including to:			
Eire	2,477	923	1,284
Gibraltar	410	88	212
Denmark	2,997	340	560
Germany	3,687	10	....
France	6,155	545	749
Algeria	887	381	253
Spain	1,004	63	79
Italy	2,260	9	115
Egypt	1,577	....	23
Argentina	2,030	2	3
Coal shipped for use of steamers, etc., engaged in foreign trade (including fishing vessels)	10,489	3,105	4,687

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THE NEED FOR *Unitized Operation* OF OIL POOLS

By
H. H. KAVELER

UNITIZATION has long been recognized as the most efficient method of producing oil and gas from a common reservoir or source of supply. Technological advancements in reservoir engineering emphasize this fact. Examples of increased recovery may be found in those states where unitization is accepted, and the increasing number of cooperatives in other states provides additional evidence of acceptance of this type operation. Education to the facts and advantages to the individual operators is needed to overcome legal barriers and the problems of equity and distribution.

UNIT operation of common sources of the oil and gas supply has been a subject of consideration by the petroleum industry for at least 23 years. It was in 1924 that Henry L. Doherty first dared to suggest to a group of successful individualists that unitization was the only proper method of operating an oil reservoir. In 23 years, the original conception of what constitutes unitized operation has been developed into a practical and modern plan of efficient management of common sources of supply.

The development of the modern idea has been influenced and aided by the great technical advances in the petroleum producing industry, particularly in the development of reservoir engineering technology. Everyone responsible for the management of producing properties now recognizes the direct dependence that oil recovery bears to the maintenance of reservoir pressure by the injection of gas or water, and most of the industry is informed of the degree of conservation of petroleum resources that can be accomplished through the operation of any common source of supply as a single lease. The literature describing the various phases involving unit agreements, operating practices, engineering foundation, and legal aspects of unit operation is by this time very extensive. A substantial amount of the literature and public discussion on the question has been given to the advantages that unitized operation would bring in more effective regulatory control and conservation of oil and gas. Except for those discussions of the legal difficulties which still exist in many states and which remain as perhaps the last barrier to a more universal acceptance of unitized method of operation, all of the literature on the subject supports and advances unitization as the most conservative production practice that can be employed in producing the nation's oil and gas resources.

It is a striking fact that no one has successfully maintained in public or in private communication, that the unitized operation of an oil and gas field did not accomplish a very substantial increase in ultimate recovery, did not achieve the ultimate in conservation of both oil and gas, or did not give to every owner a greater production of oil and gas than would otherwise have been recovered. When the case for unitized management of common sources of supply is examined from an operating, engineering, regulatory, and conservation point of view, it is very preponderantly in favor of that practice. It is not difficult, therefore, to state the case in favor of the need for the unitized method of production of oil and gas. There is good reason to urge that the barriers to more general acceptance of the principle should be eliminated.

Objectives of Unitization

The objectives of unit operation of a common source of supply of oil and gas are to accomplish the following:

1. Maximum recovery of oil and gas.
2. Conservation of natural gas and crude.
3. Elimination of unnecessary and wasteful wells.
4. Maintenance of capacity to produce.
5. Maintenance of efficient rates of production.
6. A fair and equitable distribution of oil and gas as between the parties entitled to share it.
7. Removal of "correlative rights" from primary consideration in the allocation of production.

Everyone would agree that if all these objectives could be reached, the ultimate in conservation of oil and gas could be had, a greater measure of economic stability could be given to the petroleum industry, and the problem of administration and enforcement of regulatory and conservation laws of the states would be greatly simplified. Unitized operation of oil pools can accomplish all these objectives in any pool. For that reason, unitized operation becomes a matter of urgency and necessity. The current outlook for the producing industry in the U. S. is rendered favorable or unfavorable to the extent that the industry may engage in unitized operation as the means of reaching the ultimate in conservation of the nation's petroleum resources.

It must be conceded that through unit operation of a common source of supply, the oil recovery can be materially increased, often doubled or even trebled, and the waste of gas prevented. The increased recovery of oil through unitization is measured in millions of barrels. That is oil which otherwise could not be recovered. Every competent engineer, geologist or practical oil operator, particularly those who have had some experience with unitized operation, will testify to the benefits derived. The agencies of the federal government, the Interstate Oil Compact Commission, and the various associations within the industry recognize and urge unitization as a means of obtaining the greatest ultimate recovery of oil and of preventing the waste of oil and gas. A sufficient number of pools of widely different char-

acter have been produced, or, are being produced, under unitized management to lay before the public and the industry concrete evidence of what can be accomplished.

A long list of unitized operations representing fields in California, New Mexico, Oklahoma, Louisiana and Arkansas could be cited to establish the fact that unitized operation results in substantial increases in oil and gas recovery.

One example is the Jones sand pool of the Shuler unit in Union County, Arkansas. The comparative history of that pool is represented graphically by Figure 1, wherein the reservoir pressure and gas-oil ratio history of the pool is shown as a function of the accumulated oil production. The Jones sand pool was unitized in February, 1941, approximately 3½ years after its discovery. At the time of unitization, 16 million barrels of oil had been recovered. The reservoir pressure had fallen from 3520 pounds per squire inch to approximately 1600 pounds per square inch, and the producing gas-oil ratio had risen from its initial value of approximately 750 cubic feet per barrel to 2800 cubic feet per barrel.

From July, 1941, all of the produced gas was returned to the formation for the reason that unitization permitted the 145 wells on 20-acre spacing to be operated as one lease except for ten wells on two leases which remained outside of the unit. The result is that to this date the reservoir pressure has been maintained at approximately 1500 psi. The recovery as of June 1, 1947, had reached 41 million barrels. A fact of further interest is that over this period of time, the production from the Jones sand has been maintained at approximately 8000 barrels per day. The pool has undergone little decline in the rate of production in the 6½ years of its unitized operation. The striking fact is that as of June 1, 1947, a 35 percent recovery of the oil initially in-place had been accomplished with a very substantial reserve yet remaining. The dotted curves on Figure 1 indicate that had unitized operation not been accomplished with its resultant pressure maintenance by gas injection, the Jones pool would have undergone the usual pressure depletion associated with non-unitized operation with resultant recovery in the neighborhood of only 30 to 35 million barrels of oil. Unitized operation will produce twice that much oil!

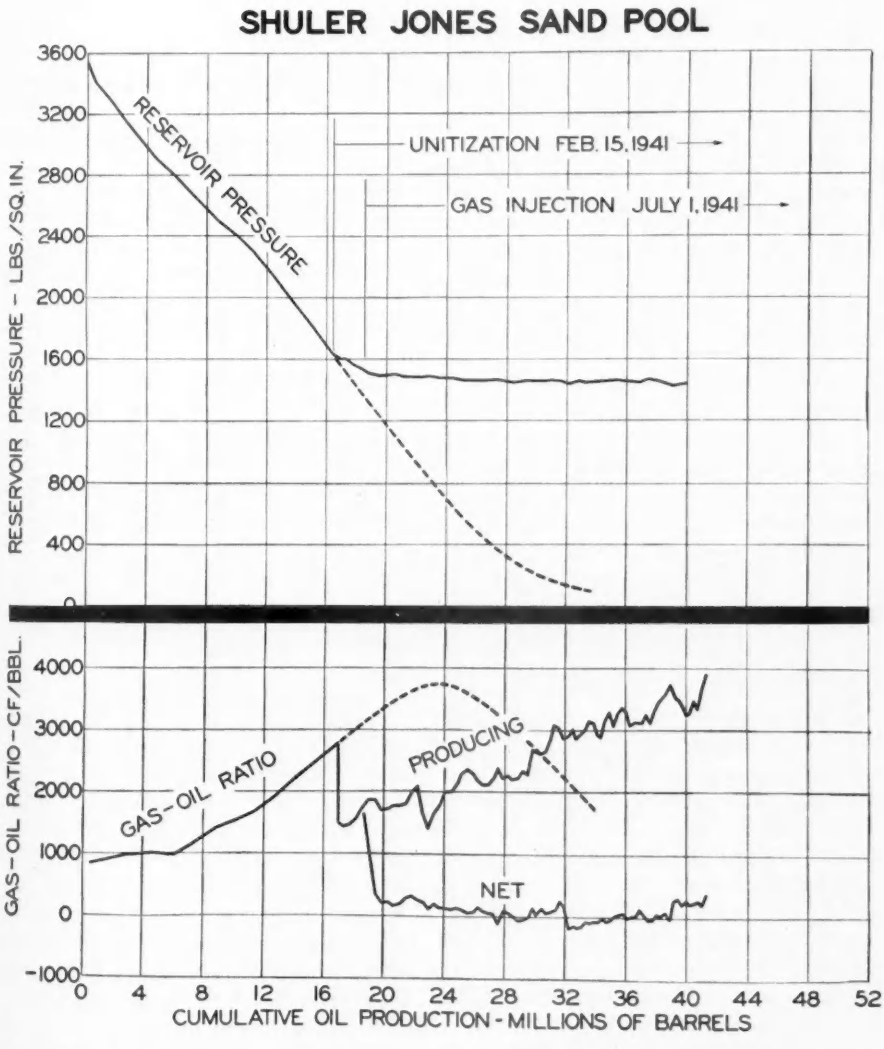


FIGURE 1. Reservoir pressure and gas-oil ratio history of the Jones sand reservoir, Shuler, Ark. The dotted curves are the estimated trends for non-unitized operation.

Another example of the benefit of unitized operation has been repeatedly referred to in the literature. It is represented by a comparison of the North Burbank field, operated on a non-unitized pressure depletion basis, as compared with the South Burbank field, operated as a unitized pressure maintenance pool from its very beginning. Both pools are in Osage County, Oklahoma, and are alike in every respect except in areal extent. North Burbank was discovered in 1923, was drilled on ten-acre spacing over an area of approximately 19,000 acres, and to date has produced under a belated cooperative repressure program commenced in 1932, about 9000 barrels per acre. South Burbank, discovered in 1935 and unitized immediately with gas injection pressure maintenance, was drilled on 20-acre spacing over an area of 2760 acres. To date this pool has produced 9000 barrels to the acre and has a substantial reserve of both oil and gas remaining. The indications are that South Burbank will produce 1.85 times as much per acre or acre-foot as a result of unitized management over the recovery that will be had in North Burbank.

Similar benefits from unit operation are evident in the operation of the Haynesville, Cotton Valley, and Erath fields in Louisiana, the Kettleman Hills field in California, Elk Basin and Salt Creek in Wyoming, and the Cunningham pool in Kansas. From a recovery and conservation standpoint, the merit of unitized operation cannot be questioned.

Example of Non-Unitized Operation

A striking example of the need for unitized operation is shown by the West Cement field of Caddo County, Oklahoma, which was the basis for an application for unitized management recently heard by the Corporation Commission of Oklahoma under the compulsory unitization law, HB 339 of the 1945 legislature.

Figure 2 is an areal map of the West Cement Medrano field. Gas was first discovered in the pool in October, 1936. There followed the drilling of 19 gas wells defining an area of gas production over about 1600 acres, whereafter in March, 1943, oil along the flank of the structure in the same common Medrano source of supply was first encountered, after which 32 oil wells were completed over an area of about 1200 acres. To January 1, 1947, approximately 60 percent of the gas originally in-place in the gas-cap had been produced, whereas only approximately 7 percent of the oil

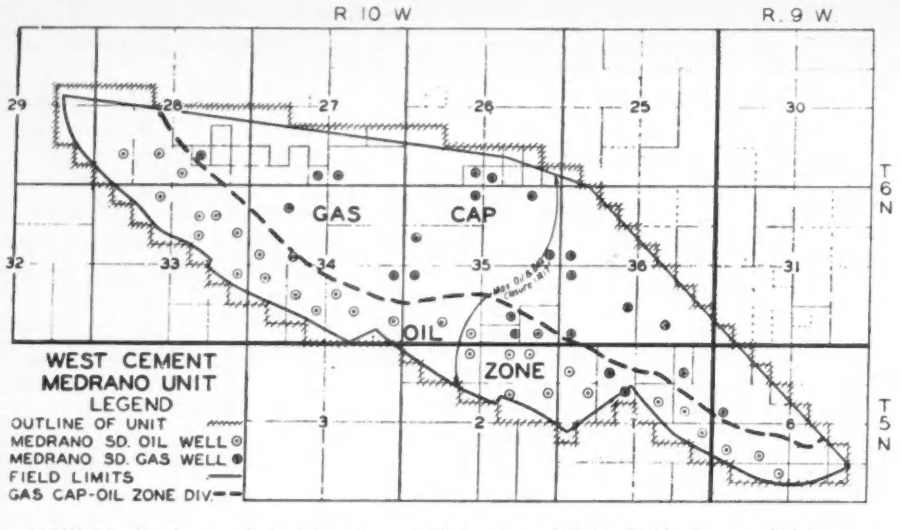


FIGURE 2. Areal map of the West Cement Medrano sand field, Caddo County, Oklahoma, showing features of proposed unit area.

originally in-place (97 million barrels), had been produced. Until the July, 1947, order of the Corporation Commission of Oklahoma reducing allowed gas-well production, the volumetric voidage from the gas zone of this field was in excess of four times the volumetric voidage from the oil zone. All of the gas-well gas was prorated on the basis of acreage multiplied by potential and sold to pipe lines.

What resulted obviously could be predicted from well-established reservoir engineering principles. There was substantial migration of oil into the gas cap area and significant pressure differentials were created, not only over the gas area but also as between the oil zone and the gas zone. The average reservoir pressure was declining at a rate to indicate that only 24 to 28 million barrels of oil would be recovered if the pool were allowed to continue in its course of decline.

If the gas wells are continued on production even at the minimum rate that might be considered to meet the requirement of the gas well owners' "correlative rights" to produce, the waste of oil will continue.

The Medrano pool has certain unusual characteristics in addition to being a large gas-cap field. The oil zone is about 95 feet thick on the average, the sandstone has a high average permeability of 300 millidarcys, and is of unusually good quality. Furthermore, the pool has a very steep structural dip in that the maximum closure of the oil- and gas-bearing structure is 1817 feet over a distance of 1¼ miles, with an average dip of 37 feet per 100 feet of distance.

This is a pool where obviously the individual interests of the owners of the gas productive acreage and that of the oil productive acreage conflict. The result of the conflict would be a substantial loss of otherwise recoverable oil. In the testimony before the Corporation Commission, the engineering conclusions presented indicated that unitization would accomplish a consolidation of the interests of the gas-owners and of the oil-owners with the result that all gas produced from the pool could be returned to the gas-cap area for the purpose of maintaining pressure, taking advantage of the very favorable reservoir conditions to substantially increase the ultimate recovery of oil by an amount at least as great or greater than an additional 24 million barrels, after which the gas conserved to the oil operation would be available for sale.

A comparative history of the Medrano pool for unitized vs non-unitized operation is shown in Figure 3 as a plot of the reservoir pressure vs accumulated oil production. To January 1, 1947, the history is actual. For "non-unitized" operation beyond that date the curve is based on the premise that "gas well" production would be restricted to volumetric equivalence to reservoir withdrawal from the "oil zone." For "unitized" operation, the curve is projected beyond January 1, 1947, on the premise that all gas produced will be reinjected into the reservoir.

In its brief aspect, there can be no question about the result that could be had in the way of increased recovery and increased benefits to all owners in interest if a pool of this character were brought under unitized management. Is there need for unitized operation of such common sources of supply? There is if the owners and others in interest intend to derive the benefit of very substantial increases in recovery and the maintenance of the potential capacity of the pool to produce oil is regarded as a necessity or even as desirable.

The fact that experience has amply and adequately demonstrated that the amount of oil and gas recovered from any pool and saved for useful purposes can be very substantially increased by unitized rather than by non-unitized operation, removes unit operation from the realm of speculation and establishes it as a real and practical means for conservation. That fact alone would appear to be sufficient to establish the need for unitized operation of any pool.

Unnecessary Wells

The recovery from an oil pool depends more upon the method by which the pool is operated than it does upon the number of wells drilled. The trend of the industry is toward 20, 40 and 80-acre spacing in oil fields. Nevertheless, there still are many examples where unnecessary wells are drilled. This is a wasteful practice. It is an evil giving rise to problems that can be met only by condoning waste and inequities between owners. The right to drill a well into a common source of supply is the vested privilege of land ownership. Although some states seek to prevent "a reckless enjoyment" of an owner's right to drill, there are abundant examples of the difficult problems in conservation and equitable sharing of production arising from irregular drilling, non-uniform well spacing, and allocation of production on a well basis without regard to other factors. In unitized operation, wells are drilled to meet the need of the recovery operation and the necessity of using a well itself for competitive advantage is removed.

One of the outstanding advantages and needs for unitized operation rests in the established fact that through unit operation the rate of production from a pool can be maintained at a high level. There is no "stripper life" in the usual sense in a unit. Pressure maintenance maintains the level of production so that even the increased recovery is had within the period that the non-unitized recovery would have been had. This is true for South Burbank, for Shuler Jones sand, and every other unit operation. Rate of production in unit operation is solely dictated by market demand and is fixed only by the economic size of the unit operating facilities.

Rates of production over a wide range are equally conservative in unit operation. This statement bears particularly upon the industry's present interest in the so-called "Most Efficient Rate" of production (MER) as a device for the allocation of production between pools. Except perhaps in those pools where natural water drive maintains pressure, the use of MER allocation in no manner improves the recovery operation. Rate is not a determining factor in recovery in the absence of steps to conserve gas, maintain reservoir pressure, and to op-

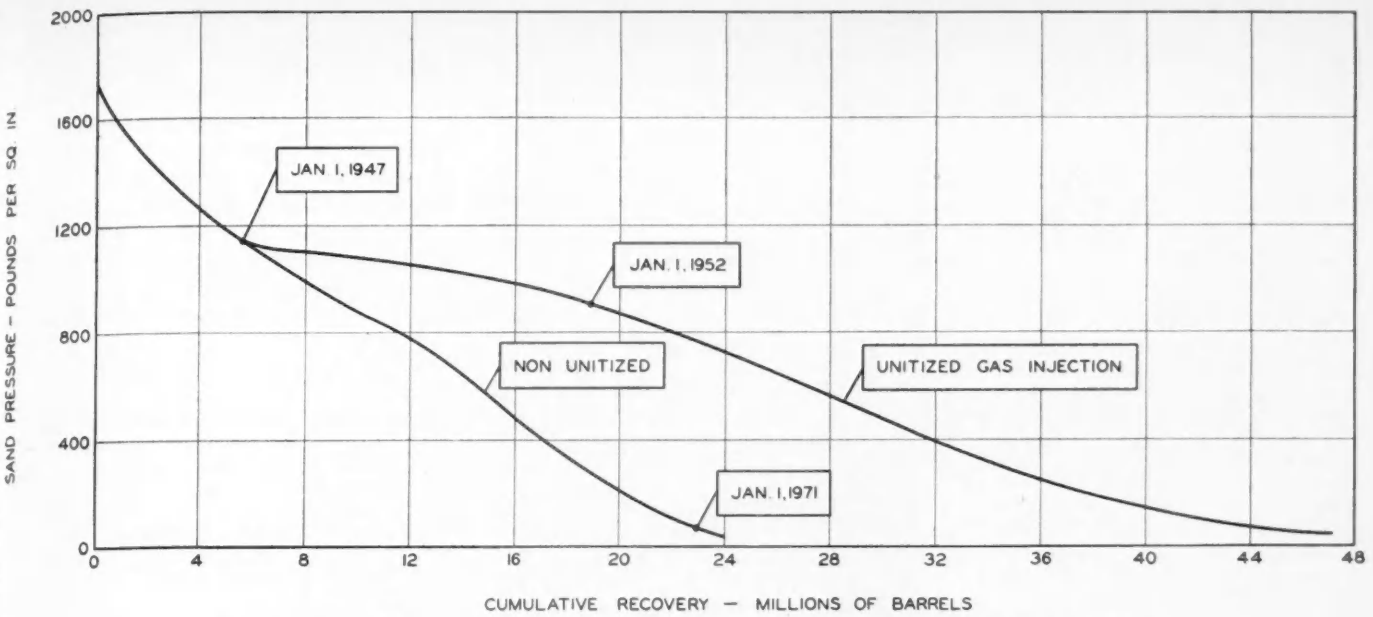


FIGURE 3. West Cement Medrano field past and prospective future reservoir pressure oil production history showing the advantage of pressure maintenance by gas-injection.

erate the common source of supply in conformance to its reservoir characteristics. Unitized operation of pools would permit the maintenance of capacity to produce and would permit the allocation of production as between pools on a much sounder and more equitable basis than has been accomplished by any past or present practice.

Equitable Sharing

Advocates of unit operation are constantly confronted with one point raised by all objectors to the plan. That point is the first problem that must be met if a unit operation is to be accomplished, namely, the division of the unit oil and gas production between the owners of the unit. It would appear that those who object to unitized operation by reason of their doubt that interest in the unit can be allocated with equity and fairness are blind to an obvious fact, which is that the *oil and gas of any common source of supply must be divided in any event.* That oil and gas are migratory and are capable of moving under even low-pressure differentials over long distances in a common source of supply, and that a well is capable of draining large areas of a reservoir are facts no longer open to serious dispute. Justice White of the United States Supreme Court, in the now famous decision, Ohio Oil Company vs State of Indiana (177 U. S. 190), speaking in the year 1900 observed:

"No one owner of the surface of the earth, within the area beneath which the gas and oil move, can exercise his right to extract from the common reservoir, in which the supply is held, without, to an extent, diminishing the source of supply as to which all other owners of the surface must exercise their rights. The waste by one owner, caused by a reckless enjoyment of his right of striking the reservoir, at once, therefore, operates upon the other surface owners. Besides, whilst oil and gas are different in character, they are yet one, because they are unitedly held in the place of deposit."

There is, and always must be, a division and distribution of the content of a common source of supply between the owners of producing acreage overlying it. In the absence of unitized operation, the burden of dividing the property rests upon the regulatory commissions of those states which have effective conservation laws, or in those states where the rule of capture prevails, the division accomplished rests with the ingenuity of the individual lease owners.

Unitization of a pool results in a fairer distribution of the oil and gas within a pool by contract between the parties than can be accomplished by any kind of proration formula within the limitations under which regulatory bodies must operate. Who is to say that under non-unitized methods of operation any tract is getting its fair share of oil and gas from the reservoir? The Supreme Court of Texas in the case of Brown vs Humble Oil & Refining Company (83 S. W. (2nd) 935) recognized the problem when it said:

"It is now, however, recognized that when an oil field has been fairly tested and developed, experts can determine approximately the amount of oil and gas in place in a common pool and can also equitably determine the amount of oil and gas recoverable by the owner of each tract of land under certain operating conditions."

Too many unit operations have been accomplished to say that it is impossible to determine the equity attributable to each tract comprising the unit. Equity distributions already have been made to the satisfaction of too many parties to regard it as an impossible problem. The matter of equity distribution and determination within a unitized operation is greatly simplified by virtue of the fact that the unitized operation will substantially increase the amount of oil and gas to be shared. Who would refuse $4.95 that he would not otherwise get merely because he thinks he should get $5? Or, who would refuse $4.95 that he would not otherwise get, because his neighbor gets $3.80, when he thinks his neighbor should receive only $3.75? The most inaccurate basis of allocation of production under unitized operation is more accurate than the best possible allocation in a prorated field operated on a non-unitized basis.

Correlative Rights

Those who have followed the efforts of conservation-minded regulatory bodies and commissions to allocate production with fairness and equity as between competitive tracts in an oil pool, appreciate the problem presented by that conflict between the "correlative rights" of a tract owner and what otherwise would prevail if equity and conservation were to be solely considered in the regulation of a pool. In a unitized operation there is but one lease. The geography of the surface is eliminated and there is no longer the impossible problem of weighing "the compensated and uncompensated drainage between tracts." In a unit operation there is no question of correlative rights, for the unit participant has his right and his share in every barrel of oil and every cubic foot of gas recovered from all of the common source of supply. The right to produce

and the right to have some share of the oil and gas from the common source of supply by mere virtue of the right bestowed by ownership of a lease or well as that right emerges from our present body of oil and gas law is a substantial barrier to achieving conservation in non-unitized operations.

This thought was expressed by R. M. Williams (addressed to the Mineral Section, Oklahoma Bar Association, Tulsa, November, 1946):

"Unitization does not disturb any basic principles of individual ownership of oil and gas in place under a particular tract of land or of an individual's ownership of his fair share of the common fund. Instead of leaving the parties alone in their attempt to make a division of the smaller part of the oil and gas several thousand feet underground, leaving the great bulk of the common property in the ground unrecovered, it provides a method whereby the common fund can be brought to the surface by the most efficient means before it is divided, thereby yielding to all what they would have gotten by competitive methods dividing the oil in the ground plus substantial volumes in excess thereof which otherwise would have been lost."

Cooperative Projects

The need for unitized operation to accomplish the objectives set forth herein is so urgent that attempts to take a small step toward this goal through resort to "cooperative" pressure maintenance projects is but an unfortunate delaying point on the road of progress. The present trend toward cooperative gas injection and the resort to cooperative water-flooding is but an expression of the fact that the industry recognizes that more oil and gas can be recovered by cooperative rather than competitive operation of leases. There are very serious limitations on the efficiency of operating "cooperative" projects for reasons that property lines still exist. This is particularly a problem in deep pools which have a large structural relief.

The need for unitized operation to accomplish the objectives of true conservation in all its phases is so great that the industry ought to come to the final realization that the only true competition in production rests in the competition to find oil reserves and to acquire the right to produce them. After a productive structure is discovered and the leasehold rights are acquired, there can be no such thing as competitive operation in the true sense of competition for the reason that the operation of a common pool and the recovery from a common source in the competitive manner can produce only a result whereby each competitor, the royalty owner, the state and the nation derives less. Petroleum is too valuable a resource to be wasted in a false tribute to what is regarded as competitive enterprise in production. It is not un-American to produce twice or treble the amount of oil and gas from a pool. It is not un-American to reach the maximum of efficiency in order that petroleum may be produced at ever-decreasing cost to the consumer and in adequate supply.

About the Author

H. H. KAVELER obtained his B.S. and M.S. from Missouri School of Mines in 1927-28, and Ph.D. in chemistry from the University of Maryland in 1931. He served as instructor in chemistry at the University of Maryland and at George Washington University; then worked one year for the Bureau of Mines. In 1936, he became associated with Phillips Petroleum Company, where he is now assistant to the vice president, dealing with reservoir analysis and production methods.

Education

The need for unitized operation in the face of the facts reduces to a need for a still more widespread education in certain quarters of the industry and most certainly of a more widespread education of royalty owners in the benefits to be derived from a cooperative rather than a competitive exploitation of common sources of supply. Beyond that the consensus appears to be that substantial assistance from legislative enactments in the several states is required. The recent order given July 28, 1947, by the Corporation Commission of Oklahoma, bringing about the unitized operation of the West Edmond Hunton lime pool as the first unitization accomplished under the unitization statute of Oklahoma, is significant perhaps in respect to the fact that that order may mark the advent of similar enabling legislation in the various states.

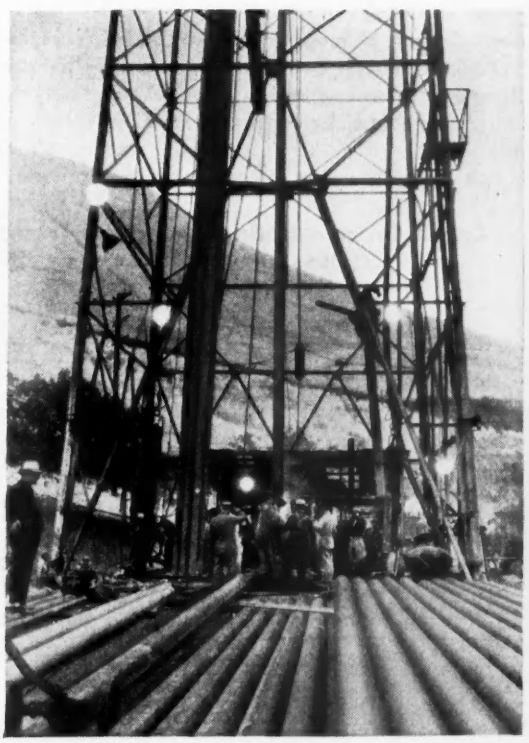
That the problem of accomplishing more unitized operation rests for the most part now on the legal barriers to unitization has been expressed by many competent authorities. For example, as early as 1928 a committee of outstanding lawyers appointed by the American Bar Association for the purpose of making a report to be submitted to the Federal Oil Conservation Board commented as follows:

"From the evidence assembled your committee is of opinion that voluntary action on the part of the industry will not in the near future, and perhaps never, meet the problem considered by this report. The reason for this conclusion is not far to seek. The answer lies in the never-changing dictates of human nature. A refiner holding a single lease in an important and prolific oil pool, needing the crude for business, will drill without restraint and produce to capacity regardless of the fact that his operations necessitate the same intensive drilling and producing campaign on the part of every other operator in the pool. Again, a producer owning one lease in a pool, driven by financial necessity or animated by the natural desire to "make hay while the sun shines," will act likewise, regardless of the consideration that his operations will be followed by a similar intensive and speedy work by his competitors in the pool. From the narrow point of view, these practices cannot be condemned. On the other hand, with the problem of national conservation at stake and taking into account also the correlative rights and obligations of the operators in the same pool, your committee cannot believe that this condition should be permitted to continue. The inquiry of your committee has involved serious economic questions as well as debatable propositions of law. We are convinced that the American petroleum industry will never find its proper place in our economic structure until it solves the problems that arise from the competitive drilling and operation of oil and gas pools. Whether that is to be accomplished by voluntary action in the industry or by the compulsion of law is yet to be determined. After an extended inquiry into the two possibilities, we have reached the conclusion that, by force of circumstances entirely beyond the control of the industry, comprehensive voluntary action is improbable if not impossible."

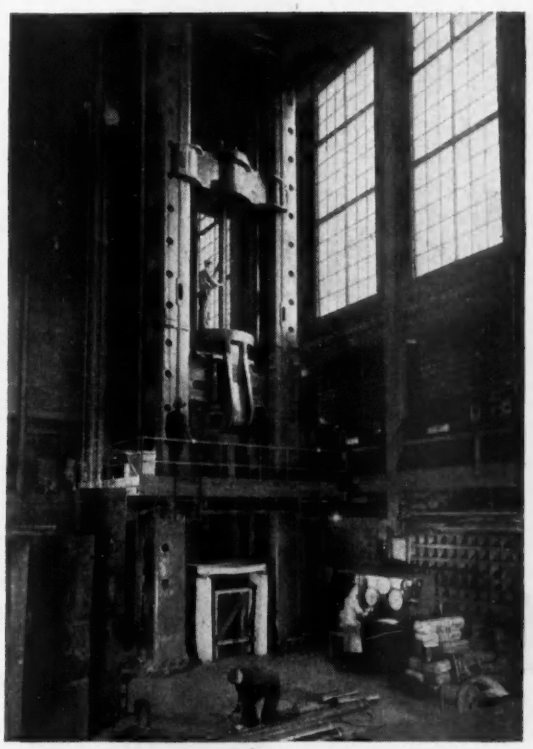
Whose Problem Is It?

In the final analysis, however, in facing the need for unitized operation of oil pools, we may search for the reason the need is not met and are likely to say that it is the lack of education, or the legal barriers that prevent the industry meeting the need. In the final and concrete analysis, unitized operation can be accomplished if the industry wants to accomplish it. The problem of meeting the need for more unitized operations is squarely up to and rests with the industry itself.

Dependability THROUGH Research



IN THE FIELD: Setting up 1133 feet of 8⅝-inch SMITHway Casing; at Santa Barbara, Cal.



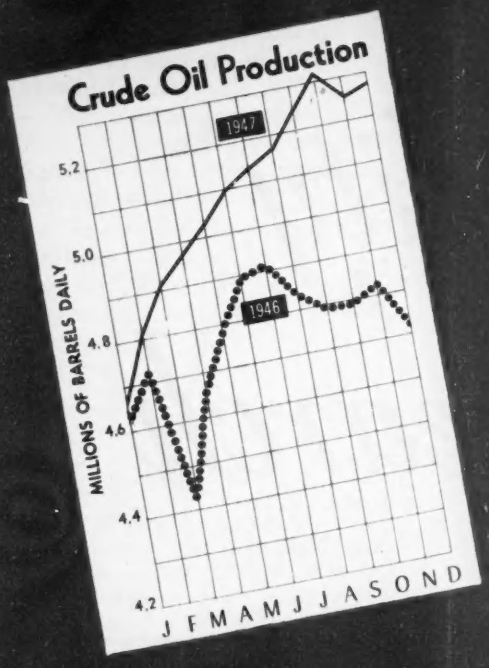
IN THE LABORATORY: Pull-out characteristics of SMITHway Casing are constantly tested.

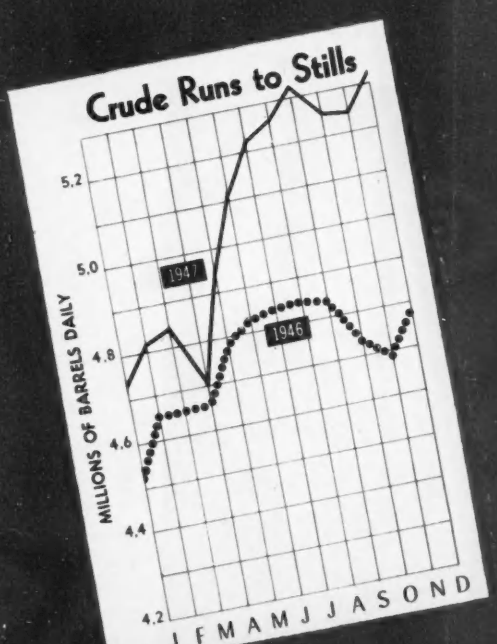
A.O. SMITH way

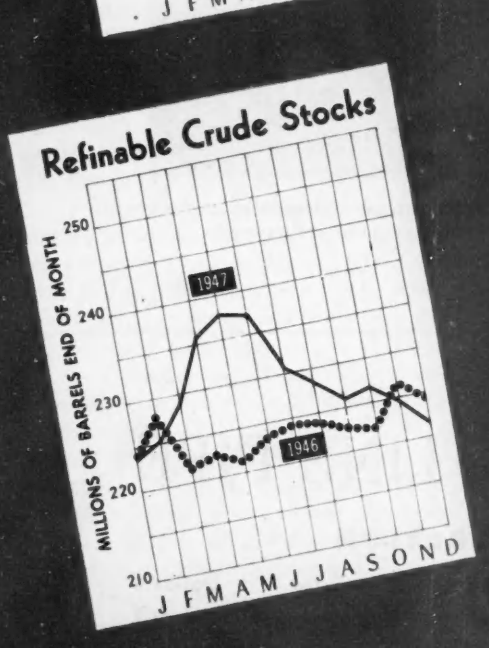
SMITH*way* CASING · LINE PIPE

A. O. SMITH CORPORATION

New York 17 • Pittsburgh 19 • Atlanta 3 • Chicago 4 • Tulsa 3 • Dallas 1
Houston 2 • Seattle 1 • Los Angeles 14 • International Division: Milwaukee 1







Petroleum

Crude Processing Hits

By CECIL SMITH

THE nation's oil refiners continue to establish new production records in order to avert a nationwide fuel oil shortage and to bring adequate supplies to the shortage areas, particularly the East Coast. The API reported that a record amount of crude was run to refinery stills during December and that output of fuel oils was far ahead of last year.

The industry, while setting new refining records, is also taking steps to improve the transportation situation, with principal East Coast suppliers preparing to take over additional tankers for the movement of fuel oils from the Gulf Coast to the East.

Crude runs to stills in December amounted to 5,324,000 barrels a day, an increase of 83,000 barrels daily over runs in the previous month and 544,000 daily over December's a year ago. This is an all-time high in refinery operations, with the previous record having been 5,260,000 barrels daily in August, 1947. In order to process this record-breaking amount of crude, the nation's refineries operated at 93.9 percent of rated capacity. The API also reported that at the end of December refineries had pushed their runs to 99.4 percent of rated capacity and they amounted to 5,637,000 barrels a day.

Production of crude during December totaled 5,274,000 barrels a day, an increase of 16,000 barrels over November's daily average and 549,000 a day more than was produced in December, 1946. December's output was not a new all-time record, but was exceeded only by October's high of 5,320,000 daily.

Output of the light fuel oils during the month amounted to 29,514,000

Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
MONTH	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1945:									
January	4,756	4,680	221,737	2,094	91,666	663	31,695	1,350	44,347
February	4,767	4,817	220,221	2,194	97,457	724	27,210	1,326	39,760
March	4,804	4,719	223,988	2,124	97,447	675	26,729	1,273	35,451
April	4,807	4,774	224,229	2,127	90,804	681	29,148	1,289	34,418
May	4,887	4,913	223,151	2,179	88,530	708	29,511	1,341	34,333
June	4,859	4,989	218,218	2,166	86,128	730	32,440	1,351	35,606
July	4,897	5,001	216,638	2,281	85,582	713	36,276	1,351	38,341
August	4,870	4,928	215,135	2,269	84,003	701	41,245	1,329	42,227
September	4,423	4,275	220,319	1,933	74,574	640	45,059	1,139	42,822
October	4,284	4,244	221,246	1,888	76,805	613	45,479	1,176	42,068
November	4,517	4,624	218,916	2,156	86,540	665	44,562	1,265	41,322
December	4,472	4,574	218,763	2,056	97,676	683	35,778	1,245	37,158
1946:									
January	4,625	4,520	223,442	1,914	102,394	787	28,990	1,224	34,573
February	4,719	4,651	227,220	1,884	104,836	823	25,511	1,243	34,008
March	4,414	4,661	221,400	1,900	104,161	816	29,922	1,213	32,995
April	4,673	4,663	222,480	1,943	98,744	773	32,064	1,247	35,206
May	4,785	4,794	221,592	2,016	93,960	753	33,385	1,220	38,932
June	4,896	4,836	223,140	2,055	91,971	777	38,824	1,219	41,492
July	4,922	4,856	224,351	2,102	87,778	793	46,439	1,163	45,446
August	4,836	4,856	224,157	2,189	86,745	765	54,068	1,159	48,186
September	4,790	4,839	222,417	2,143	87,021	796	62,019	1,150	54,012
October	4,785	4,736	222,177	2,117	85,952	788	76,780	1,090	55,580
November	4,823	4,684	226,453	2,162	88,587	791	68,145	1,101	52,735
December	4,725	4,780	224,473	2,168	92,742	805	59,912	1,159	47,094
1947:									
January	4,671	4,739	223,848	2,078	99,623	778	48,197	1,174	41,550
February	4,810	4,820	225,121	2,089	103,672	777	36,901	1,228	48,480
March	4,908	4,843	228,981	2,076	105,679	825	31,423	1,222	37,403
April	4,974	4,707	235,710	2,037	101,724	764	30,268	1,148	36,455
May	5,033	4,947	237,768	2,128	95,209	805	34,279	1,204	39,992
June	5,137	5,221	230,974	2,302	86,003	847	46,444	1,244	47,600
August	5,173	5,260	228,523	2,383	85,849	869	54,707	1,245	51,334
September	5,251	5,236	225,258	2,375	84,360	911	59,764	1,237	52,578
October	5,320	5,253	226,666	2,371	82,584	938	63,252	1,260	52,502
November	5,258	5,241	224,616	2,327	86,539	908	61,894	1,219	51,153
December	5,274	5,324	221,319	2,329	92,886	952	50,161	1,289	45,547
December, 1947 Changes:									
In Month	+16	+83	−3,297	+2	+6,347	+44	−11,733	+70	−5,606
In One Year	+549	+544	−3,154	+161	+144	+147	−9,751	+130	−1,547
In Two Years	+802	+750	+2,556	+273	−4,790	+269	+14,383	+44	+8,389

New High as Year Ends

Staff Writer

barrels for a daily average of 952,000 barrels compared to 27,253,000 barrels in the previous month which amounted to 908,000 barrels a day. A year before light fuel production had been 25,902,000 barrels, a daily rate of 805,000 barrels. In December the light oil cut from crude amounted to 17.9 percent compared with 17.3 percent yield in November, while a year ago only 15 percent was made into these fuels.

Residual fuel oil output was also upped during the month. Production averaged 1,289,000 barrels a day against 1,219,000 in the preceding month and 1,159,000 daily in December, 1946. Refinery yield of these heavy oils amounted to 24.2 percent during December, more than the 23.3 percent in the previous month, but exactly the same as in December, 1946.

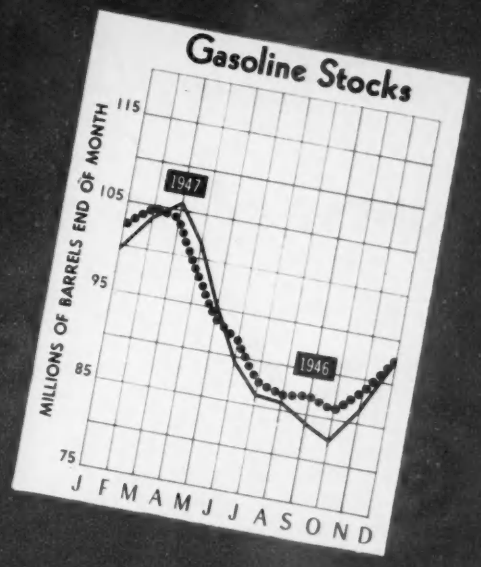
Despite increased output of the fuel oils, heavy withdrawals were made from their stocks. Distillate fuel stocks were lowered 11,733,000 barrels during December to 50,161,000 barrels, which was 9,751,000 barrels less than were on hand at the end of 1946. The month saw residual stocks decrease 5,606,000 to 45,547,000 barrels, 1,547,000 less than stocks of a year ago.

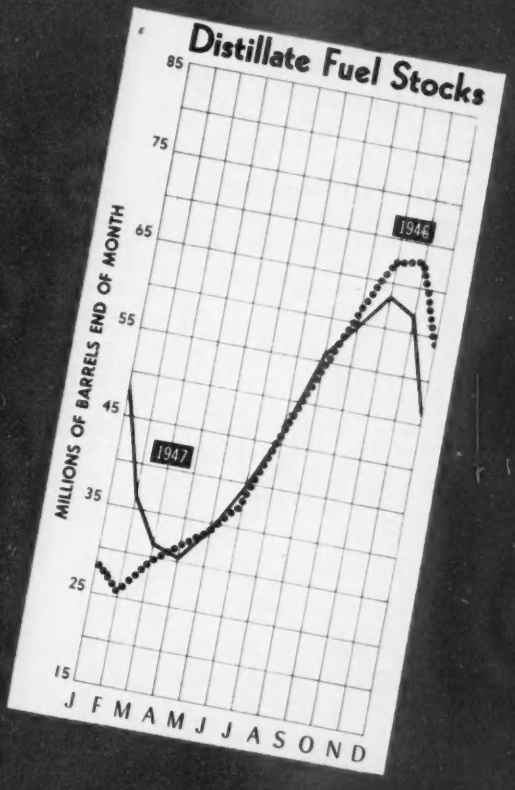
Improvement in the oil transportation situation is expected when more tank ships are made available. Fifteen oil companies serving the East Coast have agreed to accept delivery from layup of warbuilt tankers which have been bought, but not completely reconditioned. The companies took this step to speed use of the ships to bring fuel oil to the Atlantic Seaboard. These companies now have 236 privately owned tankers in domestic service. If the offer is accepted by the Maritime Commission, it will mean that 50 Liberty-type tankers and about a dozen T-2 type vessels will be hastened into service, which will help alleviate the supply shortness that cold weather brought to that region.

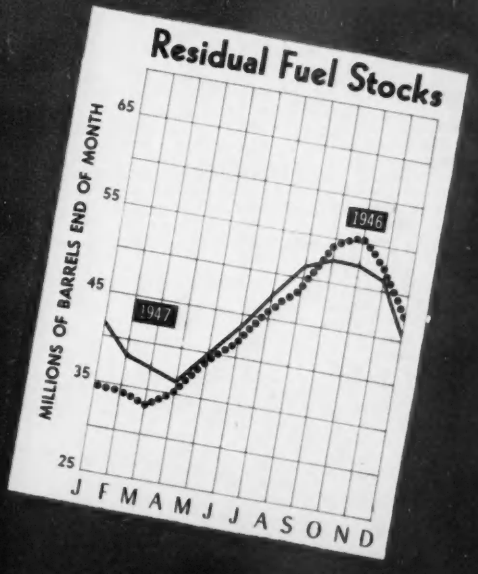
State Crude Oil Production

(THOUSANDS OF BARRELS)

STATE OR DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL TWELVE MONTHS		
	December, 1947	November, 1947	December, 1946	% Diff. Dec.'46-'47	1947	1946	% Diff.
Alabama	1.3	1.3	0.9	+ 44.4	398	380	+ 4.7
Arkansas	80.1	79.0	79.3	+ 1.0	29,609	28,375	+ 4.3
California	927.3	924.7	879.3	+ 5.5	332,958	315,179	+ 5.6
Colorado	46.0	47.5	38.2	+ 20.4	15,766	12,016	+ 31.2
Florida	0.7	0.9	0.3	+133.3	260	57	+356.1
Illinois	176.9	177.5	196.9	— 10.2	66,440	75,297	— 11.8
Indiana	18.2	18.0	18.0	+ 1.1	6,092	6,726	— 9.4
Kansas	284.4	292.1	271.0	+ 4.9	105,072	97,218	+ 8.1
Kentucky	27.8	26.6	26.5	+ 4.9	9,469	10,578	— 10.5
Louisiana	453.2	451.5	413.6	+ 9.6	159,276	143,303	+ 11.1
North Louisiana	108.2	106.4	93.5	+ 15.7	36,432	30,768	+ 18.4
South Louisiana	345.0	345.1	320.1	+ 7.8	122,844	112,535	+ 9.2
Michigan	48.5	46.5	44.0	+ 10.2	16,283	17,084	— 4.6
Mississippi	111.1	108.7	83.8	+ 32.6	35,163	24,216	+ 45.2
Missouri	0.2	0.1	0.1	+100.0	55	51	+ 7.8
Montana	24.8	24.4	22.5	+ 10.2	8,700	8,801	— 1.1
Nebraska	0.5	0.6	0.5	.....	220	265	— 17.0
New Mexico	120.4	120.2	103.0	+ 16.9	40,971	36,860	+ 11.2
New York	13.2	13.2	13.0	+ 1.5	4,787	4,863	— 1.6
Ohio	8.8	9.1	8.0	+ 10.0	3,120	2,908	+ 7.3
Oklahoma	410.4	409.8	355.0	+ 15.6	141,325	134,497	+ 5.1
Pennsylvania	31.8	32.1	34.7	— 8.4	12,563	12,996	— 3.3
Tennessee	.....	.....	0.1	—100.0	8	10	— 20.0
Texas	2,348.6	2,339.5	2,022.2	+ 16.1	817,987	760,505	+ 7.6
Dist. 1—S. Central	24.9	24.6	19.5	+ 27.7	8,120	7,075	+ 14.8
Dist. 2—Middle Gulf	163.8	162.2	138.5	+ 18.3	57,293	51,641	+ 10.9
Dist. 3—Upper Gulf	488.0	487.0	428.5	+ 13.9	174,832	167,198	+ 4.6
Dist. 4—Lower Gulf-S.W.	258.0	253.9	212.9	+ 21.2	88,102	79,662	+ 10.6
Dist. 5—East Central	42.3	41.5	34.0	+ 24.4	14,275	14,297	— 0.2
Dist. 6—Northeast	413.6	422.0	417.0	— 0.8	157,637	157,797	— 0.1
Dist. 7-B—N. Central	42.1	41.4	33.9	+ 24.2	14,180	11,983	+ 18.3
Dist. 7-C—W. Central	41.4	41.7	28.8	+ 43.8	13,704	10,070	+ 36.1
Dist. 8—West	648.7	643.5	494.1	+ 31.3	205,956	180,470	+ 14.1
Dist. 9—North	136.6	133.6	122.3	+ 11.7	47,956	45,274	+ 5.9
Dist. 10—Panhandle	89.2	88.1	81.4	+ 9.6	31,305	30,431	+ 2.9
Virginia	.....	0.1	0.2	—100.0	65	16	+306.3
West Virginia	6.9	7.2	7.3	— 5.5	2,599	2,929	— 11.3
Wyoming	133.0	127.4	106.5	+ 24.9	43,980	38,304	+ 14.8
Total United States	5,274.1	5,258.0	4,724.9	+ 11.6	1,853,166	1,733,424	+ 6.9







1947 Completions

HIGHEST IN TEN YEARS

WELL completions in 1947 showed an increase of 9 percent over the previous year's to set a new high mark for any year since the peak year, 1937, when about 35,000 wells were completed. Although the year just completed failed to set a new all-time record in the number of wells completed, it did reach a new high in footage drilled.

Records for 1947 show that 33,646 wells were completed, an increase of 9.1 percent over the 30,852 drilled in the previous year. That made the year the most active since 1937, when the all-time high of slightly over 35,000 wells were drilled. However, ten years ago those wells represented a little less than 105 million feet of drilling while the current period's, although considerably less in number, represent over 113 million feet of hole drilled. Which shows that ten years ago drilling was comparatively shallow and could be done with considerably more ease and less time. Today there are still many shallow areas that continue to attract the drillers, but the greatest expansion is going on in the deeper regions.

The year saw most of the more active states increase operations over their 1946 activities, but there were some exceptions. Illinois drilled about 13 percent less in 1947 than the year before and drilling in Montana was 8 percent less. Michigan also showed a decline by completing 8 percent less wells.

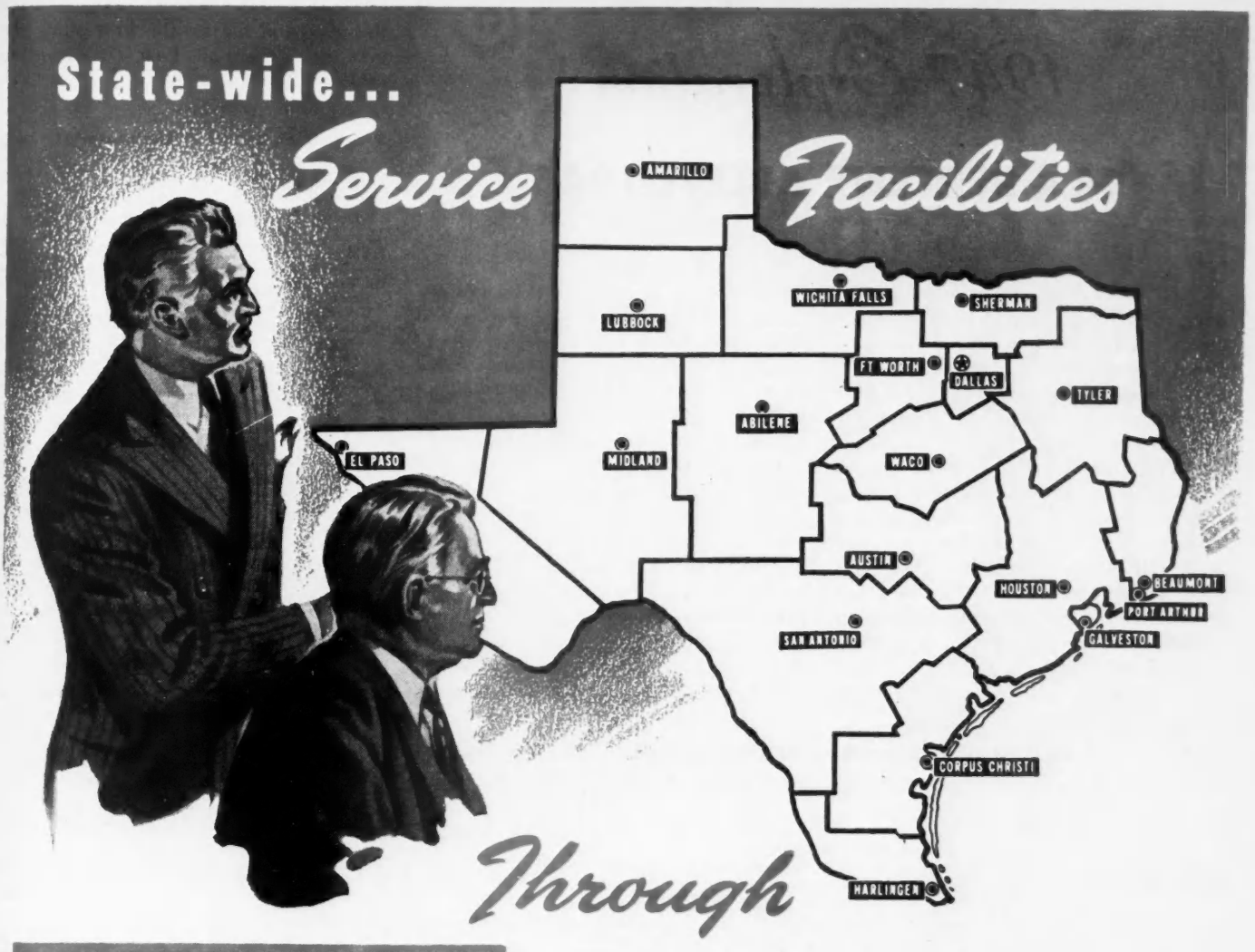
Most other oil-producing states showed increases. Texas' wells were up almost 14 percent, and Oklahoma's showed a 12 percent rise. Seventeen percent more wells were drilled in Louisiana during 1947 and California hiked its operations by almost five percent. In the Appalachian region well completions were about 2 percent more numerous. Wyoming and Colorado, in the Rocky Mountain region, recorded increases of 20 and 64 percent, respectively.

Well Completions in the United States During December, 1947, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon, and Allegany fields of Pennsylvania and New York from The Producers' Monthly)

STATE OR DISTRICT	MONTHLY COMPLETIONS, DECEMBER, 1947									TOTAL COMPLETIONS				CUMULATIVE TOTAL January-December				Rigs in Operation (Drilling, Rigging, Up and Shut Down)		
	New Wells								Total Drilled Deeper											
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New		Dec., 1947	Nov., 1947	Dec., 1946	Footage December, 1947	Wells 1947	Wells 1946	Percent Diff.	Footage 1947	Dec. 31, 1947	Nov. 30, 1947	Dec. 31, 1946
Alabama				4				4		4	3	1	23,239	30	17	+76.5	132,921	2	5	11
Arizona															2	—100.0		1	1	
Arkansas	12			15				27	1	28	40	24	114,634	330	203	+ 62.6	1,343,558	40	43	27
California	142		1	33				176		176	198	156	715,047	1,983	1,897	+ 4.5	8,121,496	275	283	323
Colorado	15			5				20		20	22	26	119,904	211	176	+ 19.9	1,162,970	63	67	56
Florida				1				1		1	1	2	1,035	29	27	+ 7.4	152,945	4	4	9
Georgia				1				1		1	1		3,705	5	2	+150.0	18,770		1	
Illinois	75		1	83				159		159	213	211	404,561	2,063	2,379	— 13.3	5,293,209	214	212	236
Indiana	30		1	28				59		59	61	51	111,717	631	522	+ 20.9	1,114,116	66	76	65
Iowa																				1
Kansas	130		53	90			5	278		278	198	227	898,393	2,650	2,221	+ 19.3	8,410,058	338	320	347
Kentucky	22		25	25				72		72	82	64	154,688	864	861	+ 0.3	1,672,407	75	84	100
Louisiana	93	8	9	56				166		166	180	124	704,142	1,667	1,422	+ 17.2	8,737,091	195	200	162
North Louisiana	67	5	7	45				124		124	99	76	359,090	1,023	810	+ 26.3	3,063,788	69	73	55
South Louisiana	26	3	2	11				42		42	81	48	345,052	644	612	+ 5.2	5,673,303	126	127	107
Maryland															1	—100.0		1	1	
Michigan	16		4	35				55	1	56	81	60	141,039	718	785	— 8.5	1,662,188	118	137	103
Mississippi	19	4		10				33		33	39	32	284,954	470	266	+ 76.7	3,942,180	58	62	52
Missouri			2	4				6		6	2	2	2,538	43	34	+ 26.5	22,866	3	6	5
Montana	14		2	9				25		25	30	14	61,181	242	263	— 8.0	552,941	61	73	47
Nebraska														3	5	— 40.0	7,987	1	1	3
New Mexico	55	1	5	10				71	2	73	55	41	331,806	607	463	+ 31.1	2,513,016	106	116	114
New York	104			4	64			172		172	164	88	248,955	1,863	1,153	+ 61.6	2,642,763	204	202	104
North Carolina														1	5	— 80.0	6,370			1
Ohio	19		43	43				105	2	107	123	116	301,577	1,347	1,326	+ 1.6	3,760,712	223	248	264
Oklahoma	193	1	12	143			1	350	10	360	264	318	1,272,090	3,707	3,301	+ 12.3	11,406,613	544	532	495
Oregon														1	2	— 50.0	8,500			
Pennsylvania	98		53	21	79	24		275	1	276	310	307	491,224	3,488	4,143	— 15.8	6,045,000	449	425	412
South Dakota															3	—100.0		1	1	2
Tennessee	1			3				4		4	4		6,809	21	14	+ 50.0	33,161	19	17	
Texas	482	13	58	255				808	20	828	817	683	4,686,080	9,518	8,382	+ 13.6	40,848,821	1,361	1,276	1,236
Dist. 1—S. Central	13			15				28		28	39	17	113,953	371	183	+102.8	1,308,773	59	58	30
Dist. 2—Middle Gulf	30	2	7	17				56		56	46	[1]	308,460	629	[1]	[1]	3,804,050	67	69	[1]
Dist. 3—Upper Gulf	40	8	9	28				85		85	71	49	581,508	877	680	+ 29.0	5,632,684	127	125	81
Dist. 4—L. Gulf-S.W.	51	2	9	42				104	4	108	91	138	533,079	1,137	1,605	+ 10.0	5,962,560	124	109	151
Dist. 5—E. Central	6		1	8				15		15	15	[2]	89,683	167	[2]	[2]	821,175	30	30	[2]
Dist. 6—Northeast	17	1	5	8				31	1	32	45	52	173,634	493	718	— 8.1	2,533,823	58	57	99
Dist. 7-B—N. Central	42		4	44				90	5	95	69	[3]	289,552	910	[3]	[3]	2,755,948	125	105	[3]
Dist. 7-C—W. Central	10		1	7				18	1	19	37	[4]	82,756	288	[4]	[4]	981,591	65	59	[4]
Dist. 8—West	147		2	14				163	8	171	222	172	814,498	2,042	1,870	+ 24.6	9,700,720	460	441	418
Dist. 9—North	81		1	67				149	1	150	128	213	445,398	2,059	2,958	+ 0.4	5,425,264	116	107	343
Dist. 10—Panhandle	45		19	5				69		69	54	42	253,559	545	368	+ 48.1	1,922,233	130	116	114
Utah											1			4	5	— 20.0	20,155	15	13	7
Virginia															2	—100.0				
Washington											1			2	1	+100.0	15,321	1	1	1
West Virginia	13		45	18				76	4	80	81	54	222,757	880	806	+ 9.2	2,373,621	384	371	391
Wyoming	20			9				29	2	31	27	12	115,580	268	163	+ 64.4	1,190,410	79	93	60
Total United States	1,553	27	314	905	143	24	6	2,972	43	3,015	2,998	2,613	10,417,655	33,646	30,852	+ 9.1	113,212,166	4,901	4,871	4,644

[1] Dist. 2 included with Dist. 4. [2] Dist. 5 included with Dist. 6. [3] Dist. 7-B included with Dist. 9. [4] Dist. 7-C included with Dist. 8. [5] Part of Bradford field now included in New York; formerly, all was carried in Pennsylvania.



SERVICE FACILITIES

The Texas Employers' Insurance Association maintains facilities whereby employers of labor in Texas can secure complete and highly specialized Workmen's Compensation Service, including:

Nineteen district service offices.
Proved financial responsibility.
Qualified rating and underwriting "know-how."
Prompt handling of claims.
Texas' largest insurance safety engineering organization.
Insurance at cost to Texas employers.

19 District Service Offices

Since the Texas Employers' Insurance Association deals directly with the employers of labor in Texas, it has set up and maintains 19 district offices to provide prompt underwriting, claims and safety engineering service to its policyholders.

Each office is staffed with trained personnel to provide whatever service is needed by the employers of labor in that particular section of the State. No industry in Texas, no matter how remotely located, is more than a few hours drive from one of these district offices.

This is just one of the reasons employers of labor in Texas secure better service from the Texas Employers' Insurance Association. This is one of the reasons the Association is the largest writer of Workmen's Compensation Insurance in Texas today.

TEXAS EMPLOYERS INSURANCE ASSOCIATION

Home Office: DALLAS • *District Offices in:* ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO • FORT WORTH GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND • PORT ARTHUR • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

1947 Exploration

14.4 PERCENT ABOVE 1946

THE year that saw almost everything pertaining to the petroleum industry hit new all-time peaks also produced a new record in exploratory drilling. Almost from the outset of 1947 indications were that the industry intended to carry on exploration at a considerably higher rate than in the record year, 1946, and it did this despite shortages of cement, drilling muds and tubular goods, of which the latter proved most critical and damaging. Not only was the total of these wells completed greater than in the previous period, but a slightly higher proportion was completed as producers.

Exploratory well completions numbered 5539 during 1947 for a gain of 697 wells or 14.4 percent over the record 4842 completed in the previous 12 months. Of these wells 1130 were rated as successful for a score of 20.4 percent in 1947, while 935 in the previous year amounted to 19.3 percent of the total.

Every year produces discoveries that range from small pumping wells to openers of flush production, and 1947 was no exception. It had its share of the marginal wells and also its quota of the better finds. West Texas was an area that fared quite well both in quantity and quality and as the year closed there came word from this district that a new well had made the discovery of the year and maybe the best since the greatest of them all, East Texas, on the other side of the state.

Summary of Results of Exploratory Drilling

ITEM	Dec., 1947	Nov., 1947	TWELVE MONTHS JAN.-DEC. 1947	1946	Percent Diff.
Oil Discoveries	65	57	717	513	+ 39.8
New Fields	40	35	424	308	+ 37.7
New Pays	25	22	293	205	+ 42.9
Distillate Discoveries	5	7	98	71	+ 38.0
New Fields	1	5	44	29	+ 51.7
New Pays	4	2	54	42	+ 28.6
Gas Discoveries	10	8	117	103	+ 13.6
New Fields	7	7	88	74	+ 18.9
New Pays	3	1	29	29	.....
Total Discoveries	80	72	932	687	+ 35.7
Extensions to Fields	19	20	198	248	— 20.2
Oil Fields	14	17	152	160	— 5.0
Distillate Fields	2	.....	17	7	+142.9
Gas Fields	3	3	29	81	— 64.2
Total Prod. Tests	99	92	1,130	935	+ 20.9
Dry Holes	401	418	4,409	3,907	+ 12.8
Wildcats	396	411	4,290	3,807	+ 12.7
New Pays	1	.....	50	38	+ 31.6
Outposts	4	7	69	62	+ 11.3
Total Expl'tory Tests	500	510	5,539	4,842	+ 14.4
Percent Productive	19.8	18.0	20.4	19.3	.....
Percent Dry	80.2	82.0	79.6	80.7	.....

Results of Exploratory Drilling in December and Year, 1947-1946, By Districts

State or District	MONTH OF DECEMBER, 1947													YEAR 1947																	
	Productive Tests									Unproductive Tests			Total Exploratory Tests	Productive Tests								Total Productive		Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions			Total Productive	Wildcats	New Pays	Outposts		New Fields			New Pays			Extensions										
	Oil	Gas	Dis.	Oil	Gas	Dis.	Oil	Gas	Dis.						Oil	Gas	Dis.	Oil	Gas	Dis.	Oil	Gas	Dis.	12 Mo. 1947	12 Mo. 1946	Wildcats	New Pays	Outposts	12 Mo. 1947	12 Mo. 1946	12 Mo. 1947	12 Mo. 1946
Alabama											4			4												24			24	13	24	13
Arizona																															2
Arkansas											11			11	5			4		2	1			12	14	72	1	1	74	56	86	70
California	1									1	26			27	10	1		11			7	3		32	29	269			269	254	301	283
Colorado	1									1	4			5	2	1					1	3		7	6	37		7	44	16	51	22
Florida											1			1											1	27			27	24	27	25
Georgia											1			1												5			5	2	5	2
Illinois	1			5			3			9	36			45	28			62	1		52	1		144	113	440			440	543	584	656
Indiana	3									3	7			10	15	1		8			1			25	15	131			131	92	156	107
Kansas	8									8	27			35	58	12					2	1		73	81	344			344	269	417	350
Kentucky											10			10	5			1			2			8	19	63			63	84	71	103
Louisiana						1			1	2	16			18	18	4	9	32		19	4		2	88	82	268	6	1	275	212	363	294
North Louisiana									1	1	14			15	7	1	3	2		1	1		2	17	16	184	5	1	190	126	207	142
South Louisiana						1				1	2			3	11	3	6	30		18	3			71	66	84	1		85	86	156	152
Maryland																													1		1
Michigan							1			1	23			24	10	4			1		6			21	27	235	1	2	238	230	259	257
Mississippi	2					1				3	5			8	5	1		1		1	3		1	12	11	88			88	79	100	90
Missouri											1			1												18			18	23	18	23
Montana				1						1	4			5	1	1		1	1		2			6	7	18	1	2	21	22	27	29
Nebraska																										2			2	5	2	5
New Mexico	1			2		1				4	5	1		10	6			3		1	2	1		13	6	60	6		66	50	79	56
New York																															1
North Carolina																										1			1	5	1	5
Ohio								1		1	1			2		3						9		12	28	43			43	45	55	73
Oklahoma	6	2	1				1			10	40			50	77	18	2	4			5	1		107	105	530		1	531	414	638	519
Oregon																										1			1	2	1	2
Pennsylvania											2			2											12	7			7	4	7	16
South Dakota																														3		3
Tennessee											3			3												18			18	14	18	14
Texas	16	5		17	3	1	8	2	1	53	163		4	220	176	37	33	161	26	31	53	9	12	538	343	1537	31	47	1615	1403	2153	1746
Dist. 1 S. Central											13			13	9			1			4			14	8	143		1	144	99	158	107
Dist. 2 Middle Gulf		2			1					3	13		1	17	8	7	14	12	7	9	3	2	1	63	[1]	115		8	123	[1]	186	[1]
Dist. 3 Upper Gulf	1			1						2	16		2	20	16	6	9	25	8	10	4		3	81	66	173	3	11	187	142	268	208
Dist. 4 L. Gulf-S.W.	2	1		8	2	1	1		1	16	30		1	47	26	12	6	47	9	10	4	2	6	122	94	258	2	15	275	325	397	419
Dist. 5 E. Central	1									1	7			8	5			3			2	2		12	[2]	73	2	1	76	[2]	88	[2]
Dist. 6 Northeast	1			1				1		3	8			11	4	2	3	4		2	1	1	1	18	26	56	3	2	61	95	79	121
Dist. 7-B N. Central	4	2		1						7	32			39	40	7	1	24			1			73	[3]	249	7	1	257	[3]	330	[3]
Dist. 7-C W. Cent.	1							1		2	4			6	18			3			4	1		26	[4]	40	2	1	43	[4]	69	[4]
Dist. 8 West	1			2			5			8	9			17	22	1		17	2		21			63	50	127	5	5	137	168	200	218
Dist. 9 North	5			4			2			11	30			41	27	2		25			9		1	64	99	283	5	2	290	561	354	660
Dist. 10 Panhandle											1			1	1							1		2	20	20	2		22	13	24	13
Utah																									1	4			4	4	4	5
Virginia																														2		2
Washington																										2			2	1	2	1
West Virginia											1			1		3								3	22	8			8	11	11	33
Wyoming	1						1			2	5			7	8	2		5			11	1	2	29	13	38	4	8	50	21	79	34
Total U. S.	40	7	1	25	3	4	14	3	2	99	396	1	4	500	424	88	44	293	29	54	152	29	17	1130	935	4290	50	69	4409	3907	5539	4842

[1] Dist. 2 included with Dist. 4 [2] Dist. 5 included with Dist. 6. [3] Dist. 7-B included with Dist. 9. [4] Dist. 7-C included with Dist. 8.

PLANS AND SPECIFICATIONS

Coordinating fine individual parts to provide control at all times

Gray Systems of Well Control provide complete control during and between all operations. They provide for the use of master valves, blowout preventers, strippers, and other available control equipment throughout their entire period of usefulness. Then provision is made for the disassembling and removal of these expensive parts, with control, to the position of accessories for use on other wells. This coordination and simplification means fewer parts of higher quality, less space occupied, height of structure reduced, and fewer parts left in the permanent well structure to give trouble and need repair.

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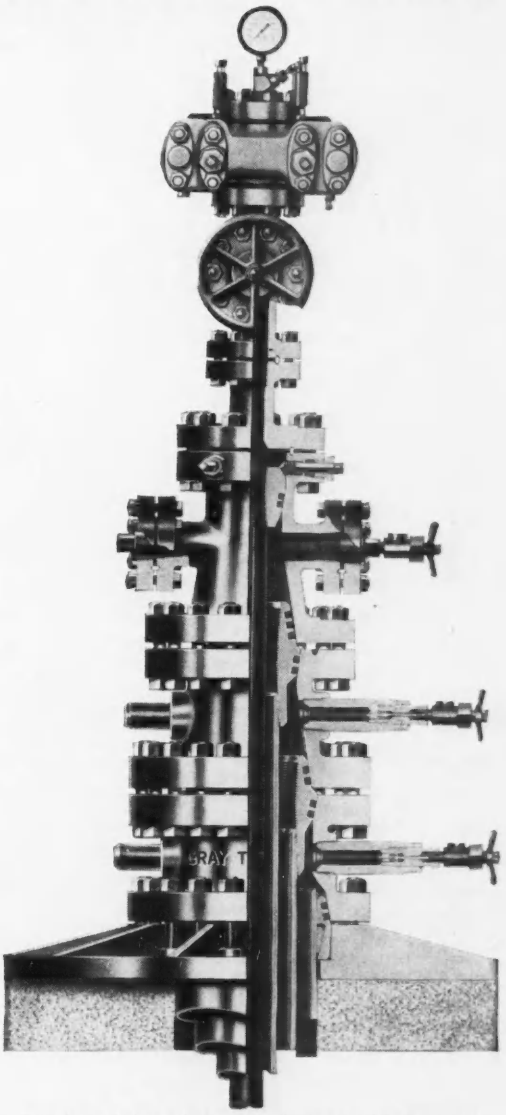

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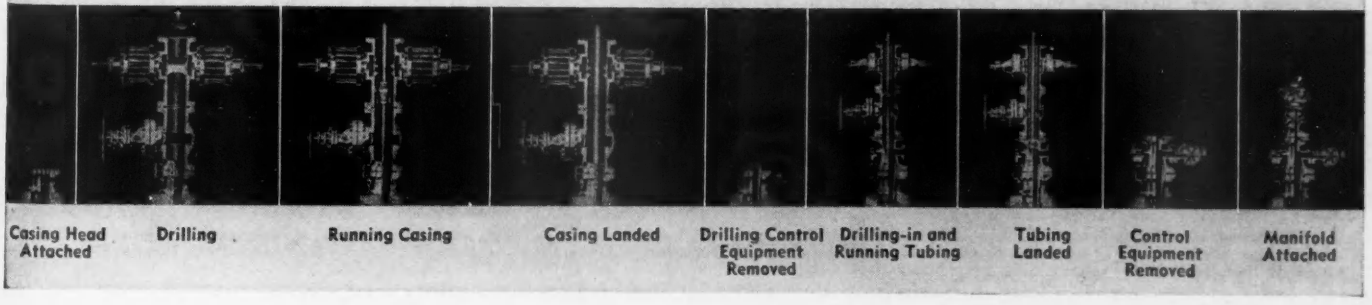


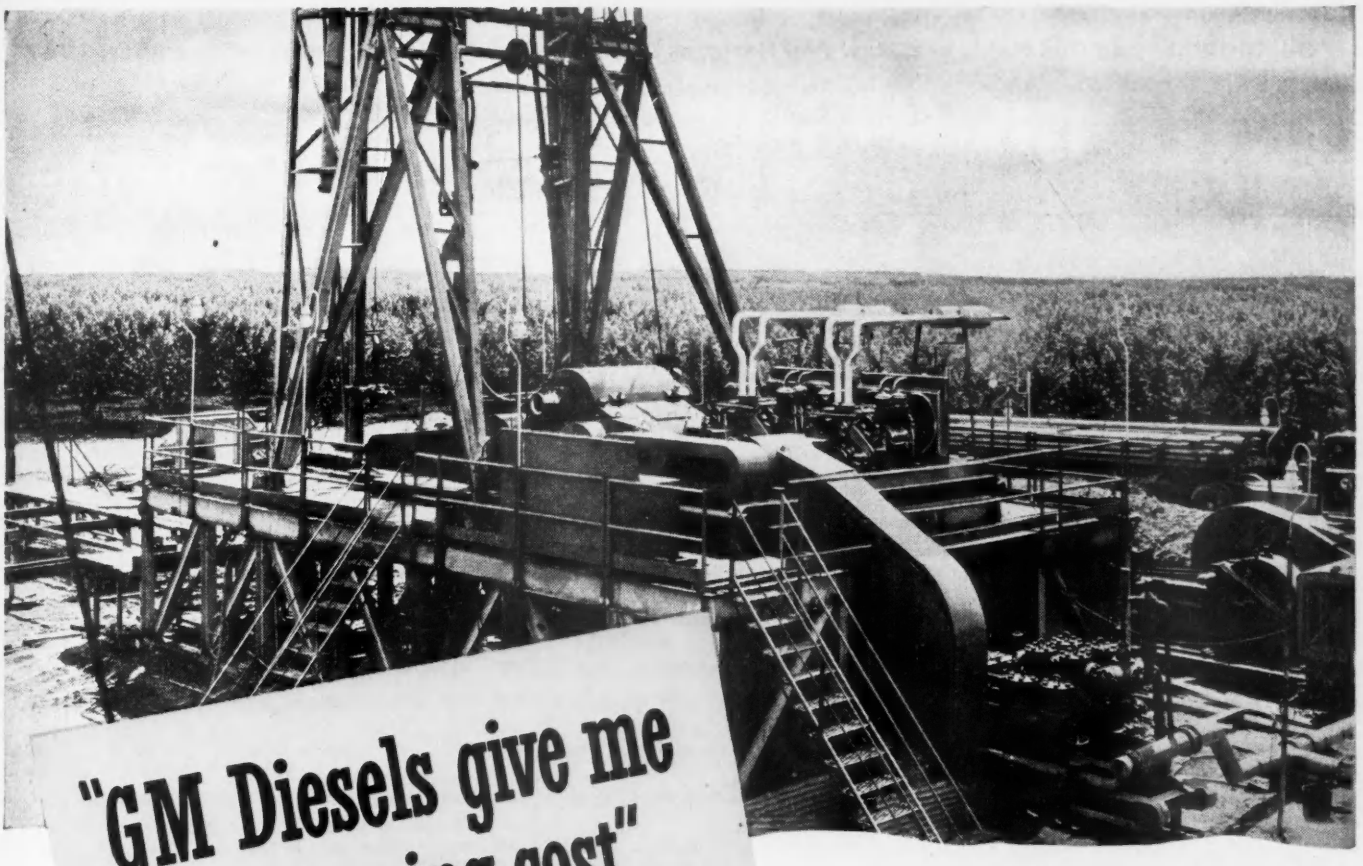
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in December, 1947

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		CALIFORNIA—New Oil Field						
Fresno		Pacific Western Oil Corp's Waechter 24, 3 mi e San Joaquin, 330 n 990 e of w¼ c Sect 32-15s-17e.	12-20-47	7062	7032- 7038	Eocene	F 220	28
		COLORADO—New Oil Field						
Moffat	Maudlin Gulch	Frontier Refining & Texas Co's Unit 1, (OWWO) ne nw nw 35-4n-95w	12- 2-47	6350	6054- 6229	Morrison sd; Jur	P 61; 37 wtr	35
		ILLINOIS—New Oil Field						
Jefferson	Divide, E.	National Associated Pet. Co's D. McElravy 1, sw sw se 17-1s-4e	12-29-47	2647	2637- 2644	Aux Vases sd; Miss	P 109; 17 wtr	....
		ILLINOIS—New Oil Pays						
Clay	Sailor Springs	P. Fulk's Stanford 2, nw sw se 9-3n-7e	12- 9-47	2989	2943- 2950	L. O'Hara li; Miss	P 200	....
Edwards	Ellery, S.	Henman & Gher's H. E. Perkins 1, n sw sw 33-2s-10e	12-29-47	3346	3220- 3249	Aux Vases sd; Miss	P 20; 5 wtr.	....
Wabash	Browns	Cherry & Kidd's Gray-Newman 5, 826 fr nl 330 fr el 4-2s-14w	12- 9-47	3031	2364- 2378	Tar Springs sd; Miss	P 90; 40 wtr	....
White	Herald	B. M. Heath's M. E. Austin 1, sw se nw, 32-6s-9e, 1½ mi w of prod	12-16-47	2506	1922- 1934	Degonia sd; Miss	P 66; 20 wtr	....
White	Maunie, N.	J. H. Gilliam's Slemaker 1, se sw nw, 36-5s-10e	12-29-47	3125	3033- 3039	Rosiclare li; Miss	P 101; 10 wtr	....
		ILLINOIS—Oil Field Extensions						
Richland	Calhoun Cons.	O. Weston's E. O. Kirk 1, sw se sw, 29-3n-10e, 1 mi n extension	12-16-47	3168	3134- 3144	McClosky li; Miss	P 140	....
White	Grayville, W.	B. Lambert's Robinson Heirs 1, sw se ne, 27-3s-10e, ⅞ mi s extension	12- 9-47	2871	2856- 2862	Cypress sd; Miss	P 63	....
White	Leech Consol.	Nation Oil Co's C. E. Haefele 1, sw nw sw 20, 3s-9e, ½ mi extension	12- 9-47	3478	3454- 3459	McClosky li; Miss	P 43; 20 wtr	....
		INDIANA—New Oil Fields						
Pike		S. D. Jarvis' R. L. Gladish 1, se sw nw 24-1n-9w, 1 mi fr Union Bowman prod.	12-23-47	1645	1310- 1323	Oakland City sd; U Miss	P 20; 10 wtr	....
Vanderburgh		Joe Reznik's W. F. Feil 1, sw sw sw 28-4s-10w, 6 mi n Vanderburgh fld, 12 mi n Evansville.	12- 9-47	2214	2210- 2214	L O'Hara li; Miss	P 217	....
Vanderburgh		Geo. S. Engle-Ind. Farm Bureau's A. C. Helfrich 1, ne sw se 18-6s-11w, 3 mi w Evansville, 2 mi fr prod.	12-30-47	1876	1860- 1876	Waltersburg sd; U Miss	SW 168	....
		KANSAS—New Oil Fields						
Barton	Ehly	R. L. Williams' Ehly 1, se se nw, 9-18s-11w, 1 mi n Ames pl	12-16-47	3318	3312- 3318	Arbuckle li; Ord	P 95; 78 wtr	46
Ellis	Younger, N.	Ben F. Brack Inc's Hoffman 1, ne ne sw 32-13s-17w, ¾ mi n Younger pl	12-30-47	3598	3580- 3598	Arbuckle li; Ord	P 100	....
Marion		E. H. Adair's Jensen 1, sw sw ne 27-22s-4e, 1½ mi s Peabody pl	12-16-47	2448	2439- 2448	Mississippi li; Miss	P 100	....
Marion		Albert Goering's Wenger 1, nw nw sw 11-21s-3e, 5 mi ne Peabody pl	12- 9-47	2782	2771- 2782	Hunton li; Miss	P 50	37.4
Rice	Rick, SE.	E. H. Adair & El Dorado Ref. Co's Chamberlain 1, nw nw ne, 18-19s-10w	12-16-47	3337	3334- 3337	Arbuckle li; Ord	P 376	....
Rooks		Derby Oil Co's Jelinek 1, nw ne se 23-9s-19w, 2 mi s Barry pl	12-30-47	3552	3537- 3552	Arbuckle li; Ord	SW 540	....
Russell	Forrest Hill, N.	Harbar Drlg. Co's Meier 1, ne ne ne 20-15s-12w	12-30-47	3283	3270- 3283	Arbuckle li; Ord	P 5	....
Sedgwick	Curry	Drillers Gas Co's Rombach 1, c nl nw ne, 11-27s-1w, nw edge of Wichita	12-23-47	2740	2715- 2720	Kansas City li; Penn	P 72	....
		NORTH LOUISIANA—Distillate Field Extension						
De Soto	Logansport	Skelly's Thelma Nash 1, 200 fr s&wl, sw ne, 20-12n-16w, 1½ mi nw ext	12-18-47	11664	6160- 6180	L. Pettit li; L. Cre	F 211; 5/8"	44.6
		SOUTH LOUISIANA—New Distillate Pay						
St. Landry	Krotz Springs	Gulf Ref Co's Haas-Hirsch 1-E, (OWWO), 3008 s 1888 e of nwc 21-6s-7e	12-12-47	12298	6822- 6854		249: 5 mln	69
		MICHIGAN—Oil Field Extension						
Osceola	Reed City	Jetter & deKrafft's Kearnes 1, nw sw se 26-18n-10w, ¾ mi e ext	12-12-47	3780	3105- 3108	Traverse li; Devo	P 42	....
		MISSISSIPPI—New Oil Fields						
Jones	West Ovett	Gulf Ref Co's L. L. Majors 1, 567 fr sl 559 fr el ne 29-6n-11w, 4 mi e & 9 mi s of Ellisville.	12-19-47	13251	12095-13082	Glen Rose dolo; L Cre	F 91; ¼"	31.2
Wayne		J. Willis Hughes & Walter E. Sistrunk's G. M. & O. R. R. 1, ne ne sw 24-9n-8w, 8 mi nw Waynesboro.	12-29-47	5151	4966- 5151	Eutaw sd; U Cre	P 187	19.5
		MISSISSIPPI—New Distillate Pay						
Jones	Soso	Gulf Ref Co's Knight et al Unit 1, sw nw ne 33-10n-13w	12-20-47	6680	6448- 6462	Stanley sd; U Cre	19; 2.6 mln	58
		MONTANA—New Oil Pay						
Carbon	Elk Basin, NW	Sinclair-Wyoming Oil Co's Helen-Gov't 1, se ne ne 29-9s-23e	12- 4-47	3451	3376- 3447	Basal Frontier sd; U Cre	SW 66	45
		NEW MEXICO—New Oil Field						
San Juan		Byrd, Frost, Inc et al's Hargrave Federal 1, 660 fr nl 1980 fr wl 4-27n-10w.	12- 4-47	6745	6490- 6520	Dakota sd; U Cre	F 10; 1.3 mln	50
		NEW MEXICO—New Oil Pays						
Eddy	Grayburg-Jackson	Leonard Oil Co's Leonard-State 8, (OWDD) 1177 fr sl 1230 fr el 21-17s-29e.	11- 7-47	4211	2600- 2715		F 45; open	....
Lea	Brunson	Gulf Oil Corp's McCormack 11, 554 fr n&el Sect 32-21s-37e	11-24-47	8318	7150- 7221	Silurian	F 487; ¾"	43.6
		NEW MEXICO—New Distillate Pay						
Lea	Justis	R. Olsen Oil et al's Wimberly 1, 1980 fr nl 660 fr el 23-25s-37e	12-12-47	9152	4740- 4770	Permian	F 25; 2.8 mln	dist.
		OHIO—Gas Field Extension						
Summit	Ashland	Wiser Oil Co's J. G. McCready 1, Lot 73, Northampton twp, 3 mi e ext.	12-26-47	3645	3570- 3600	Clinton sd; Sil	0.2 mln	....
		OKLAHOMA—New Oil Fields						
Cleveland	Moore, E.	Faultline Oil Co's School Lands 1, c ne nw 36-10n-2w	12-11-47	7406	7128- 7147	Simpson sd; Ord	F 240	37.2
Garvin	Antioch, NE.	Western Oil Co et al's Hamilton 1, nw se sw 11-3n-2w, 1 mi ne Antioch pl.	12-11-47	6194	5764- 5788	Simpson sd; Ord	F 192; 11/64"	43.4
Garvin	Brady, E.	Ray Hoffman Jr. & Shirley Thompson's McClain 1, sw nw nw 25-2n-1w.	12-11-47	4680	4610- 4645	Pennsylvania sd; Penn	P 83	39.5
McClain		Fred Morgan's Harrison-Hunter 1, ne ne se 30-5n-3w, 1 mi e of Lindsey, NE pl.	12-18-47	10171	9950- 9980	Bromide sd; Ord	F 301; 1/4"	40.7
Pontotoc		Walter Duncan's Bayne 1, ne se 1020 s 1020 w 17-5n-6e, 1 mi e Wetley pl.	12-18-47	2008	1742- 1754	Sand	P 96	....
Stephens		Howell's Gatlin 1, se se se 2-1s-6w	12- 4-47	7507	5930- 5946	Deese sd; Penn	P 40	....
		OKLAHOMA—Oil Field Extension						
Oklahoma	Witcher	Peppers Refining Co's Hayes 1, c sw se 32-13n-2w, se extension	12- 4-47	6332	6275- 6332	Bois D'Arc-Hunton li; Devo	P 75	....
		OKLAHOMA—New Distillate Field						
Pontotoc		Belgam Oil Co's Britt 2, ne sw sw 20-4n-7e	12-18-47	1492	1482- 1492	Gilcrease sd; Penn	F 20; 57 mln; open	dist.
		OKLAHOMA—New Gas Fields						
Creek		Bates & Springer's Fulsom 1, se se se 13-15n-8e	12-11-47	3800	3124- 3136	Dutcher sd; Penn	7.8 mln	....
Okfuskee		Public Service's Rose 1, (OWDD) c nw se 28-10n-12w	12- 4-47	2711	2687- 2711	Sdy Wapanucka li; Penn	0.5 mln	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Fields						
Live Oak	Baker	W. E. Rowe's Earl M. Baker et al 1, 330 fr el 990 fr sl Seale & Morris Sur 7.	12- 9-47	3513	2002- 2025	Jackson sd; Olig	4 mln; open	....
Victoria	Jamie	Rowan & Hope's Sally Ragsdale 6, 6306 fr wl 330 fr nl Sally Ragsdale Tr, in s part of Valentin Garcia Gr, 1½ mi ne Telferner, E, fld.	11-19-47	5348	5102- 5108	Frio sd; Olig	57 mln; open	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Pay						
Calhoun	Matagorda Bay	Stanolind O & G Co's State of Texas Tr 104, 1, 660 fr s&wl of Tr 104, in Matagorda Bay, 1½ mi n-nw of disc well.	11-30-47	5657	5044- 5049		2.7 mln; ¼"	....
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Field						
Hardin	Beach Creek, E.	American Republics Corp's C. M. Votaw-Fee 1, C. M. Votaw (H&TC) Sur. 4 mi e-ne of Beach Creek fld, 678 fr wl 1800 fr sl of Sect 200.	12-20-47	7587	6417- 6419	Cockfield sd; Eoc	F 179; 1/8"	39
		TEXAS—District 3 (MIDDLE GULF COAST)—New Oil Pay						
Colorado	Columbus	Pan American Prod Co's Ola Buescher 1, Jas Cummins Sur, start sec lse at Rocky Hill Rd, go 2170 w alg sl of lse, th 660 n at ra.	12-14-47	9365	8375- 8385	Wilcox sd; Eoc	F 68; 1/8"	45.9
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Oil Fields						
Hidalgo	Javelina	Continental Oil Co's Lloyd M. Bentsen 1, 17,050 fr nl 3950 fr wl "Los Guages" Segundo Flores Gr near Starr Co line, 8 mi e Rincon fld.	12- 1-47	9919	5389- 5421	Frio sd; Olig	F 225; 4/64"	42.5
San Patricio	New Angelita	Continental Oil Co's J. F. Welder Hrs 1-S, 12,000 w of el of Victoria Tares & Pedro Villareal Sur, 5 mi s-se of Edroy.	12-10-47	7601	5976- 5998	Frio sd; Olig	F 129; ¼"	40.8
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Oil Pays						
Duval	Piedras Pintas (Segment G)	H. H. Howell's Magnolia Pet Co 2, 660 s of Magnolia 1, 740 fr n'ly sl, 2115 fr w'ly wl of J. Poitevent Sur 185.	12- 5-47	3027	2190- 2198		F 265; 4/64"	48.5
Jim Wells	La Gloria	Magnolia Pet Co's Ed L. Weathers 1, 330 fr nel of lot 2, Blk 8, subd of Lds adj to tws of La Gloria.	12- 3-47	7500	7273- 7278	Stanley sd; Mio	F 145; 5/64"	40.2
Jim Wells	Stratton	Humble's King Ranch-Stratton 10-A, 5153 s of nl of Paso Ancho de Arriba Gr and of 20,832.9-ac lse & 2696 w of el of lse.	12-26-47	7495	5304- 5313		F 97; 1/8"	44.4
Nueces	Luby	Seaboard's K. L. Shaffer 2, (OWDD) 466 fr wl 1400 fr sl of 531.74-ac lse Sect 3, Blk 2, M. J. Luby Subd, Canutillo Colony Ditch Co Sur 933.	12-10-47	7575	7437- 7439		F 84; 1/8"	36

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; sur, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.



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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in December, 1947

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
Nueces	Stratton	Chicago Corp's G. P. Wardner Tr 32, (OWWO) 467 fr n&wl Sect 8 Chas Stratton Subd, Paso Ancho de Arriba Gr.	11-29-47	6822	5816- 5824		F 104; 1/8"	44.6
San Patricio	White Point E.	Plymouth Oil Co's M. K. & L. B. Cole 3-G, 330 fr wl 660 fr sl of sw¼ ne¼ Sect 50 Geo. H. Paul Subd, of Coleman-Fulton Pastr.	12- 9-47	6788	6782- 6787		F 242; 1/8"	42.4
Starr	Kennard	Coastal Refineries Inc, & W. D. Kennard's E. M. Garcia 4-E, 330 n of sl of Sur 970 on 231-ac "E" lse, & 660 w of E. Garcia No. 2.	12-30-47	4185	4018- 4032	"K" sd; Olig	F 82; 7/64"	42.6
Starr	Sun, N	Sun Oil Co's Enrique Garza 1, 467 fr s&el of Lot 11 & of 167.23-ac lse out of shares 10 & 11 of La Sal Colorada Gr, abt ½ mi n of prod.	11-20-47	7505	7022- 7037	Vicksburg sd; Olig	F 128; 11/64"	35.7
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—Oil Field Ext.						
Duval	Hoffman	Humble O & R Co's James R. Dougherty 3-B, 990 fr swl 2700 fr sel of SK&K Sur 503, on 1426-ac "B" lse, 660 ne Dougherty 2-B.	12- 8-47	2306	2278- 2296		F 146; 7/32"	22.5
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Dist. Pay						
San Patricio	Plymouth	Sun Oil Co's J. M. Hunt et al 9, 466 fr el 995 fr sl of 154.39-ac lse, Blk 34, Taft Farm Lds, J. Fessenden Sur.	12- 7-47	6966	6741- 6746		F 7; 4.8 mln; ¼"	63.5
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—Dist. Field Ext.						
San Patricio	Edroy	Southern Minerals Corp's Mrs. C. H. Gerdes 1, 467 fr nl 990 fr wl (at ra) of 248-ac lse in Sect 53, Geo. H. Paul Subd, 1 mi ne extension.	12-22-47	5959	5938- 5948		F 253; 23 mln; open	
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Gas Fld						
Starr		W. B. & Jewel Osborn & Mid-Continent Pet. Corp's John Clopton 2, 560 fr el 780 fr sl of Tr 5, Evans Subd in s part of Porc 86.	12-12-47	4006	629- 637		0.4 mln; ¼"	
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Gas Pays						
Hidalgo	McAllen	Coastal Refineries Inc & Mayfair Mineral's Jackson-Harrison 1, (OWDD) 100 fr nl 530 fr el, Lot 3, Blk 10, Steele & Pershing Subd, of J. A. Villarreal Porc 64.	11-15-47	8419	6926- 6936		5 mln; open	
Nueces	Chapman Ranch	Seaboard Oil Co's J. O. Chapman 15, 467 fr n&el of Sect 46, Laureles Fm Trs, 1590 sw Chapman 2.	12- 6-47	9520	4574- 4580	Oligocene	33 mln; open	
		TEXAS—District 5 (EAST CENTRAL)—New Oil Field						
Denton		Harvey Drlg Co's J. B. Waide 1, 750 fr sl 1650 fr wl of T. Carpenter Sur.	12-10-47	1668	1657- 1668		P 26	
		TEXAS—District 6 (NORTHEAST)—New Oil Field						
Cherokee		General Crude Oil Co's J. W. Summers et al 1, 467 s of nl, 1107 e of wl of John Hunt Sur, 4 mi w of Wm. Wise fld.	12- 6-47	5136	5133- 5136	Woodbine sd; U Cre	F 115; 3/16"	41.7
		TEXAS—District 6 (NORTHEAST)—New Oil Pay						
Marion	Jefferson	Paul H. Pewitt's W. C. Ralph 1, (OWDD), 471 out of n'ly nwc of 77-ac Tr & Eli Ussery Sur, 3 mi n Jefferson.	9-24-47	6631	6432- 6454	U Pettit li; L Cre	F 552; 5/8"	45
		TEXAS—District 6 (NORTHEAST)—Gas Field Extension						
Harrison	Longwood (Louisiana)	Sam E. Wilson Oil Co's Hearne Estate 1, 2100 fr sl 660 fr el W. C. Baker Sur, extends fld into Texas.	12-19-47	6115	5579- 5602	Pettit li; L Cre	8 mln; open	
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Fields						
Jones		Ungren & Frazier et al's H. L. Bartlett 1, 330 fr s&el of ne¼ Sect 43, Blk 2, SPRR CO Sur, 10 mi sw Anson.	12-24-47	3242	3230- 3242	Swastika sd; Penn	F 575; ¼"	42
Palo Pinto		W. K. Gordon's J. W. Conway 8, 330 fr n&wl Sect 59, Blk 2, T&P Sur.	12- 9-47	3572	3562- 3572		F 26	40
Stephens		Star Oil Co's Walker-Buckler 2, 2800 fr nl 3050 fr wl, Nancy Williams Sur.	12-17-47	4502	4480- 4502	Mississippi li; Miss	F 176; 3/16"	42
Wise		Cities Service's B. O. Manning et al 1, 4900 fr sl 330 fr wl J. Tarleton Sur.	12-16-47	7052	5203- 5235	Bend cgl; Penn	F 164; 3/16"	41.8
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Pay						
Throckmorton	Howsley	Jas H. Snowden et al's L. A. Howsley 2, 2800 fr sl 2750 fr el BBB&C Sur, 300, twin nw offset to Mississippi disc.	10- 4-47	4254	4201- 4207	Bend li; Penn	F 890; ½"	40.2
		TEXAS—District 7-B (NORTH CENTRAL)—New Gas Fields						
Callahan		B. F. Phillip's Nat H. Williams 1, 150 fr n&wl of Sect 139, University Sur.	11- 3-47	575	565- 575		8.1 mln	
Eastland		Lone Star Prod Co's G. P. Mitcham 1, 900 fr sl 2050 fr wl, Sect 491, SPRR CO Sur, 5 mi nw Cisco.	12-10-47	4551	3946- 3964		1.8 mln	
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Field						
Upton	Alford	Slick & Urschell Oil Co's D. L. Alford 1, (OWDD) 2173 fr nl 4813 fr wl Sect 50½ Blk Y, P. B. Scott Sur, 12 mi ne Rankin, 9 mi nw Big Lake fld.	12- 4-47	12022	11020-12022	Ellenburger li; Ord	F 888; 3/8"	58
		TEXAS—District 7-C (WEST CENTRAL)—Gas Field Extension						
Crockett	Olson	Plymouth Oil Co's J. W. Owens 1-O-A, 1989 fr nl 2001 fr wl Sect 6, Blk GG, H&OB Sur, 1½ mi s extension.	11-20-47	6270	1085- 1100	Soma sd; Perm	0.5 mln; open	
		TEXAS—District 8 (WEST)—New Oil Field						
Hockley		Stanolind O&G Co's F. F. Bozeman 1, 660 fr n&wl, Lab 11, Lge 43 Raines CSL Sur, 1½ mi ne Slaughter pl, 2½ mi sw Levelland pl.	11-28-47	4889	4796-	Permian	F 262; ¾"	29
		TEXAS—District 8 (WEST)—New Oil Pays						
Cochran	Landon	Stanolind O&G Co's M. J. Hall 1, 1980 fr sl 538 fr wl Sect 13, Blk L, PSL	12-11-47	11166	10410-10541	Strawn sd; Penn	F 321; 3/16"	39
Ector	Goldsmith	Gulf's Goldsmith 437, 1333 fr el, 440 fr nl T&P Ry, Sur 28, Blk 44, T-1-S.	11-12-47	6700	5600- 5620	Clear Fork li; Perm	F 1049; ½"	38.3
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Crane	Crossett	Texas Co's C. W. Hobbs 3-B, 1980 fr nel 660 fr sel Sect 45, Blk 35, H&TC Sur, s extension.	12-23-47	5348	5238-	Devonian	F 342; 3/32"	45.0
Ector	Andector-Ellenburger	Humble O&R Co's R. B. Cowden 2-H, 1980 fr sl 660 fr el Sect 1, Blk 45, T-1-N, T&P Sur, se extension.	12-30-47	8622	8355- 8400	Ellenburger li; Ord	F 2382; 5/8"	42.8
Ector	TXL-Devonian	Mid-Continent Pet Corp's TXL 1-P, 660 fr nl 1980 fr wl Sect 45, Blk 45, T-1-S, T&P Sur, s extension.	12-21-47	7885	7780- 7785	Devonian	F 141; ½"	39.6
Ector	Frank-Cowden Ellenburger	Phillips Pet Co's Blakeney 2, 1980 fr s&wl Sect 7, Blk A, PSL Sur, 1¼ mi se extension.	12-30-47	8495	8475- 8495	Ellenburger li; Ord	F 1552; ½"	45
Winkler	Keystone-Colby	Cactus Drlg. Co's B. F. Jenkins 3, 1320 fr sl 440 fr wl Sect 6, Blk 77, PSL Sur, n extension.	12-17-47	3581	3450- 3581	San Andres li; Perm	F 34; ¼"	37
		TEXAS—District 9 (NORTH)—New Oil Fields						
Archer		Southern Pet Exploration Co & Sohio's L. F. Wilson "E" 1, 330 fr n&el Wm Walker Sur, 5½ mi n Archer City.	12-16-47	4267	3680- 3800	Strawn sd; Penn	P 20; 100 wtr	
Cooke		V. D. Randall & F. H. Kiel's V. D. Randall 1, 990 fr el 821 fr sl Jacob Lawson Sur, 3 mi se Gainesville.	12-14-47	1607	1602- 1607	Pennsylvanian	P 12	
Montague		Texas Co et al's D. B. Benson 1, 660 fr n&wl of se¼ Sect 1, Limestone CSL, 4 mi sw Hildreth pl.	12-24-47	6468	6236- 6244	Bend cgl; Penn	F 1192; ¾"	41
Young		Warren Oil Corp's Mary T. Bellemy "D" 1, 467 fr sl 1267 fr wl of n½ Sect 718, TE&L Sur, 1 mi s Profitt.	12-30-47	4895	4810- 4895	Ellenburger li; Ord.	P 15	40
Young		Warren Oil Corp's Ida E. Brooks 1, 330 fr nl 933 fr wl B. W. Russell Sur.	12-30-47	4659	4155- 4162	Caddo li; Penn	F 16; 11/32"	41
		TEXAS—District 9 (NORTH)—New Oil Pays						
Clay	Acme	S. D. Johnson & Acme Die & Mach Co's Carl Mobley 3, 2303 fr el 5450 fr nl of T. Morehead Sur, 3 mi nw Deer Creek.	12-26-47	4600	4589- 4600	Vogtsberger sd; Penn	P&F 163	45
Clay	Ross, W.	Fain & McGaha and Drlg & Exploration Inc's Ross Hrs 1-B, 330 fr wl 1210 fr sl of 240-ac lse, BBB&C Ry 8.	12-10-47	4838	4816- 4838	Strawn sd; Penn	F 359; 23/64"	42
Young	Young County Regular	Panhandle Prod & Ref Co's W. Brundidge 2, 1185 fr wl 330 fr sel of farm Apr, 925 fr nl H. M. Jones Sur, 2 mi e Kendall fld.	12-29-47	4505	4454- 4474	Mississippi li; Miss	F 149; ¼"	42
Young	Holbert	Warren Oil Corp's C. L. Griffin 2-B, 990 fr nl 660 fr el Sec 727, TE&L CO	9-15-47	2593	2586- 2593	Strawn sd; Penn	F 151; ¼"	
		TEXAS—District 9 (NORTH)—Oil Field Extensions						
Archer	Chalk Hill, N.	Henry Grace's L. F. Wilson 2, 330 fr n&wl of sw¼ Sect, Lot 3, Blk 72, ATNCL Sur, 1 mi se extension.	12-27-47	3963	3947- 3963		F 1264; ¾"	43
Jack	Antelope	Cox Drlg Co's Spearman Est 1, 330 fr s&el of n/230 of s/372 of Sect 2, SPRR Sur, 1 mi sw extension.	12-20-47	5029	4814- 4830	Caddo li; Penn	F 300; 3/16"	40
		WYOMING—New Oil Field						
Park	S. Shoshone	Continental Oil Co's Unit 1, sw ne nw 25-50n-105w	12-20-47	4843	3705- 3760	Embar li; Perm	SW 25	18.1
		WYOMING—Oil Field Extension						
Weston	Mush Creek	Morton Oil Co's R. Michaels 1, ne nw nw 26-44n-63w, 1¾ mi s extension.	12-20-47	3908	3872- 3896	Newcastle sd; U Cre	F 200	

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; sur, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

Mechanical Problems in DEEP DRILLING

IMPORTANT FACTORS limiting the scope of deeper drilling are discussed here. Surface equipment trends indicate that manufacturer and engineer are in accord as to physical rig requirements. However, engineering problems must be studied and rig requirements coordinated to meet unknown factors which may be encountered in future deep drilling.

By J. I. MORRIS,
University of Tulsa

THE growing demand for petroleum and its derivatives makes it imperative for the American oil industry to:

1. Step up its discovery rate to create large additional reserves.

2. Direct its exploratory program towards the development of such reserves within the continental borders of the U. S. in order to make this country independent of its petroleum needs in peace and war.

While it is true that new oil is being found to supplement current reserves of approximately 20 billion barrels, we cannot overlook the fact that demands are increasing steadily and that, unless important new discoveries are made to balance the withdrawals of approximately 5 million barrels daily of current production, the industry may arrive at a point where withdrawals far exceed replacement and the country may have to draw upon more costly sources such as coal and shale.

Although there is much unexplored potential oil territory in this country, an objective glance at the production picture reveals that the flush production from shallow areas is virtually exhausted and the industry must seek for larger reserves at greater depths. The trend is revealed by the fact that between 1935 and January 1, 1947, 326 wells were drilled below 12,000 feet. Included are 116 producers, of which 99 were successfully completed below 10,000 feet. The trend of wells drilled below 12,000 feet is graphically shown in Curve 1, Figure 1. If the trend is maintained the industry should see more than 140 wells drilled below the 12,000-foot level by early 1948.

Using 12,000 feet or more as the yardstick for a deep well for purposes of discussion, it is interesting to note that the first such was Gulf Oil Corporation's McElroy 1 in Upton County, Texas, completed at 12,786 feet in 1935 as a dry hole. Three years later Continental Oil Company drilled a test in Wasco, Calif., to 15,004 feet and later plugged back to 13,180 feet to complete for 3000 barrels per day, initial production, becoming the deepest producer of record to that time. Cooley[1] lists seven progressive depth records between 1935-46, starting with Gulf's Upton County, Texas, record-breaker at 12,786 feet and concluding with Pacific Western Oil Company's Kern County, California, test bottomed at 16,668 feet, later surpassed by the Superior Oil Company of California's Weller 51-11, Caddo County, Oklahoma, drilled dry to 17,823 feet. Today, the world's deepest producer is The Texas Company's LaFourche Basin Levee District 1, Jefferson Parish, Louisiana, completed at 13,904 feet.

About the Author

J. I. MORRIS has been giving special study to the many factors which influence deep drilling and believes the ingenuity of American engineers will overcome whatever problems may present themselves in order to reach maximum depths in the search for new oil and gas reserves. His first oil field job was as roustabout for Stanolind Oil & Gas Company. He is presently serving as graduate assistant at the School of Engineering, University of Tulsa. During the war he was with the Navy as an engineering officer in the amphibian corps. He is a native of Sidney, Mont.

It is significant that no depth records were established between 1938 and 1944 but that the trend towards deeper drilling which had remained static during that interval, then started upwards due to increased demands for crude and continues so at the present time. A study of the "ebb and flow" of deep drilling is interesting to mechanical and production engineers as it reveals representative problems which confront the operator who seeks new reserves at deeper levels. A clear picture of the trend in deeper drilling and production depths through recent years is presented by Curves 1 and 2 of Figure 1. Some records stood up over a period of years, explaining the discrepancy in the successive progression of the ordinate scale.

Oversize Equipment

The mechanical engineer considers that within certain limits and disregarding the economic factor, surface equipment may be enlarged to accommodate the requirements of deeper drilling, and designers have in fact developed "oversize" component rig parts.

Shell Oil Company has developed a 204-foot derrick capable of handling

"thribbles" of 5 9/16-inch drill pipe with overall length of stand at 132 feet. Also in use is a 178-foot derrick which handles 120-foot stands of drill pipe. These derricks may be compared to the standard 136-footer.

One company has developed drawworks capable of handling 3½-inch outside diameter drill pipe to 20,000 feet. Another has developed drawworks capable of handling 4½-inch OD drill pipe to 15,000 feet. Still another has developed a traveling block, water table and wire line specifically designed for deep drilling.

Although steam generally has been used as prime mover in most deep drilling operations, the trend is toward internal combustion engines of the diesel type, and diesel electrically-driven rigs.

Power transmission methods trend towards hydraulic drive applied to couplings designed to transmit power to drawworks, rotary table, mud pumps and transmission apparatus used as a torque converter to the drill string.

These are just a few of the developments of surface equipment which have resulted from the exigencies for more adequate equipment in deeper drilling and they indicate that, from a mechanical standpoint, the problems inherent in this type of operation can be solved.

There are, however, other important factors and problems which limit the scope of deeper drilling such as the limit of size and weight of drill pipe and casing, as well as certain physical problems encountered in such operations.

Research and production practices indicate both pressure and temperature increase with deeper penetration from the earth's surface. The temperature gradient shows a somewhat constant increase with depth and usually can be predetermined with a fair degree of accuracy in known areas. The temperature gradient in the Midcontinent area is approximately one degree per 45 feet of depth. The average pressure gradient in the same area is 46.5 pounds per 100 feet; pressures on the Gulf Coast sometimes reach almost a pound per foot of depth.

Temperature and Pressure

Temperatures increase more or less directly with depth, the geothermal gradient in the vicinity of oil-bearing structures frequently being about one degree Fahrenheit above atmospheric temperature for each 50 feet of depth. Studies of the temperature gradient in a number of oil fields have indicated rates of temperature increase with depth, ranging from one degree Fahrenheit for each 30 feet to one degree for each 70 feet.

The various temperature gradients are shown in Curves 7, 8, 9 and 10 of Figure 2. In plotting these data it is assumed that the existing surface temperature is 60° F., and that the temperature gradient varies directly and in a straight line relationship with depth. These curves do not give the exact temperature to be found with respect to depth but do provide a good indication of the limits of temperature to be expected at various depths.

Pressures encountered with increased depth vary over much greater range than temperatures. Original formation pressures in oil reservoirs increase directly with depth below the water table in the formations with which they are intercommunicable, the observed pressures averaging about 45 pounds per square inch per 100 feet of depth. The approximate reservoir pressure may be predicted by multiplying the depth in feet by 0.465 pounds, which is approximately the pressure exerted by a column of sea water. Occasionally, however, pressures greatly in excess of any that might conceivably be created by the existing water head are encountered. This might be accounted for by an impervious sealing of the reservoir and compaction of formations by pressures imposed by the weight of overlying sediments. Pressures as great as 64 percent above the normal value have been recorded in Gulf Coast fields.

Much research and study was done on the subject of abnormal formation pressures by Cannon[2] and in order to graph-

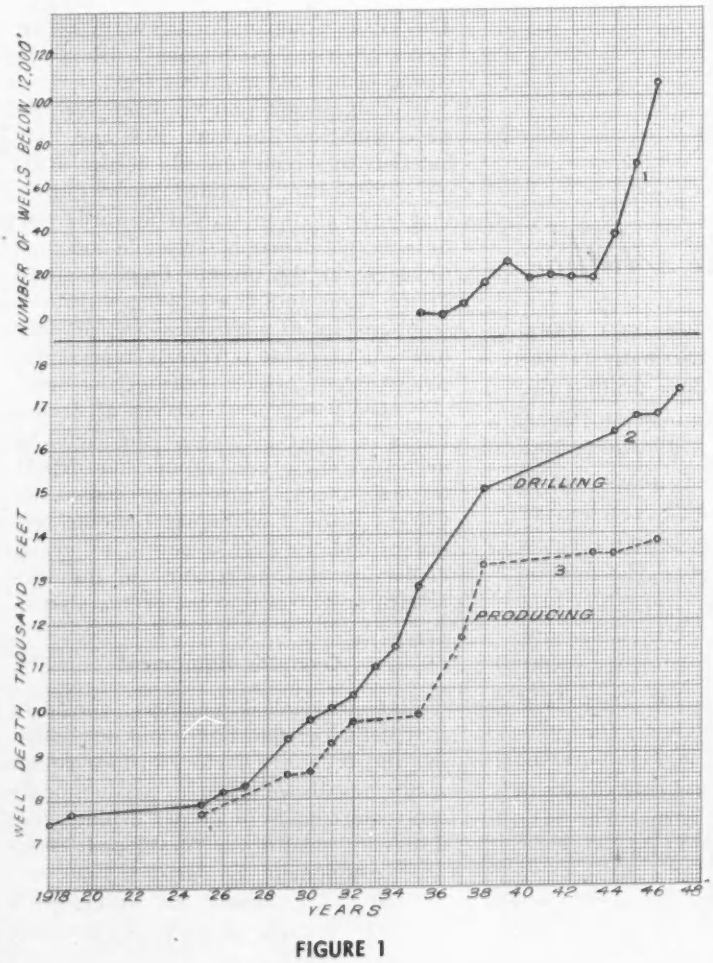

FIGURE 1

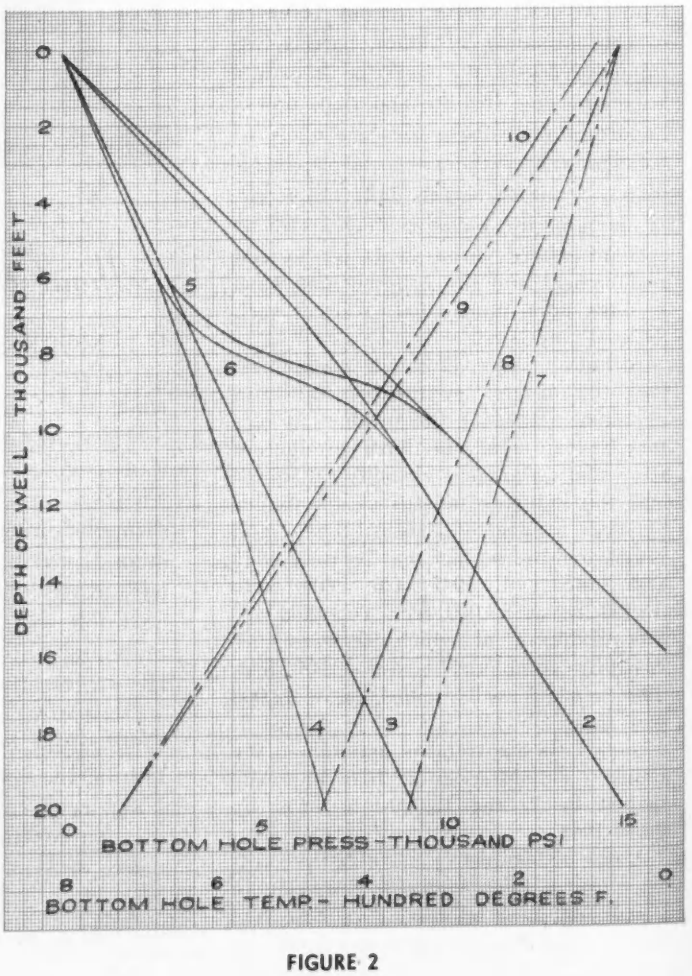

FIGURE 2

ically illustrate his point he prepared a series of curves (Figure 2).

Although no data are available to show increased abnormal pressures being encountered below 10,000 feet, the factor of abnormal pressures has a direct effect on deep drilling. Should abnormal pressures fail to indicate a marked increase below 10,000 feet, pressure is still much in excess of the expected normal gradient and drill pipe and casing must be worked through these abnormal areas of pressure and must be made to withstand these conditions. Specifically, a greater collapse pressure is placed on the drill pipe and casing. To date the major portion of deep production has been found in or near areas which have revealed abnormal pressure gradients.

Drill Pipe

Since drill pipe is the means for transmitting controlled power to the bottom of the hole as well as for carrying drilling fluid to the same point, the process involves numerous mechanical and metallurgical problems. Drill pipe is the means by which the torque from the rotary table is transferred to the actual cutting tool, the bit.

Drilling fluid has a very important effect on the stresses imposed upon the drill pipe. It serves: (1) to lubricate drill pipe in the hole and thus decrease wear on tool joints; (2) to maintain internal pressure which decreases possibility of failure due to collapse; (3) to cool the bit; (4) to bring cuttings to the surface; (5) to wall the sides of the bore hole; (6) to facilitate control of formation pressures.

The main stresses imposed on drill pipe are the torque stress exerted by the rotary table; the tensile stress resulting from the dead load of the drill pipe while going into or coming out of the hole; the tendency to collapse under drill-stem tests. In addition, drill pipe must withstand abrasion due to wear of its outside surface while rotating against the wall of the hole. Drill pipe also may be subjected to changes in load so as to cause failure by fatigue, although this factor is relatively unimportant in comparison with the other stresses.

To meet the problem of developing the most dependable drill pipe for rotary drilling the American Petroleum Institute, in cooperation with steel mills, has adopted standard specifications that govern most of the drill pipe manufactured for use by the petroleum industry. API drill pipe is of seamless construction, is made in three grades having minimum tensile stress varying from 75,000 to 100,000 pounds per square inch, and is available in sizes from 2⅜ to 6⅝-inch OD, fabricated in three ranges varying from 18 feet to 38 feet in length, and available in internal or external upset types.

The dead load of a rotary drilling string is shown in Curve 1 of Figure 3. As indicated, the dead load increases in a straight line relationship with depth. Collapse, tensile, and internal resistance, in general, decrease with increased diameter of drill pipe above 3½-inch OD. Drill pipe in general use is 3½, 4½ and 5-9/16-inch OD.

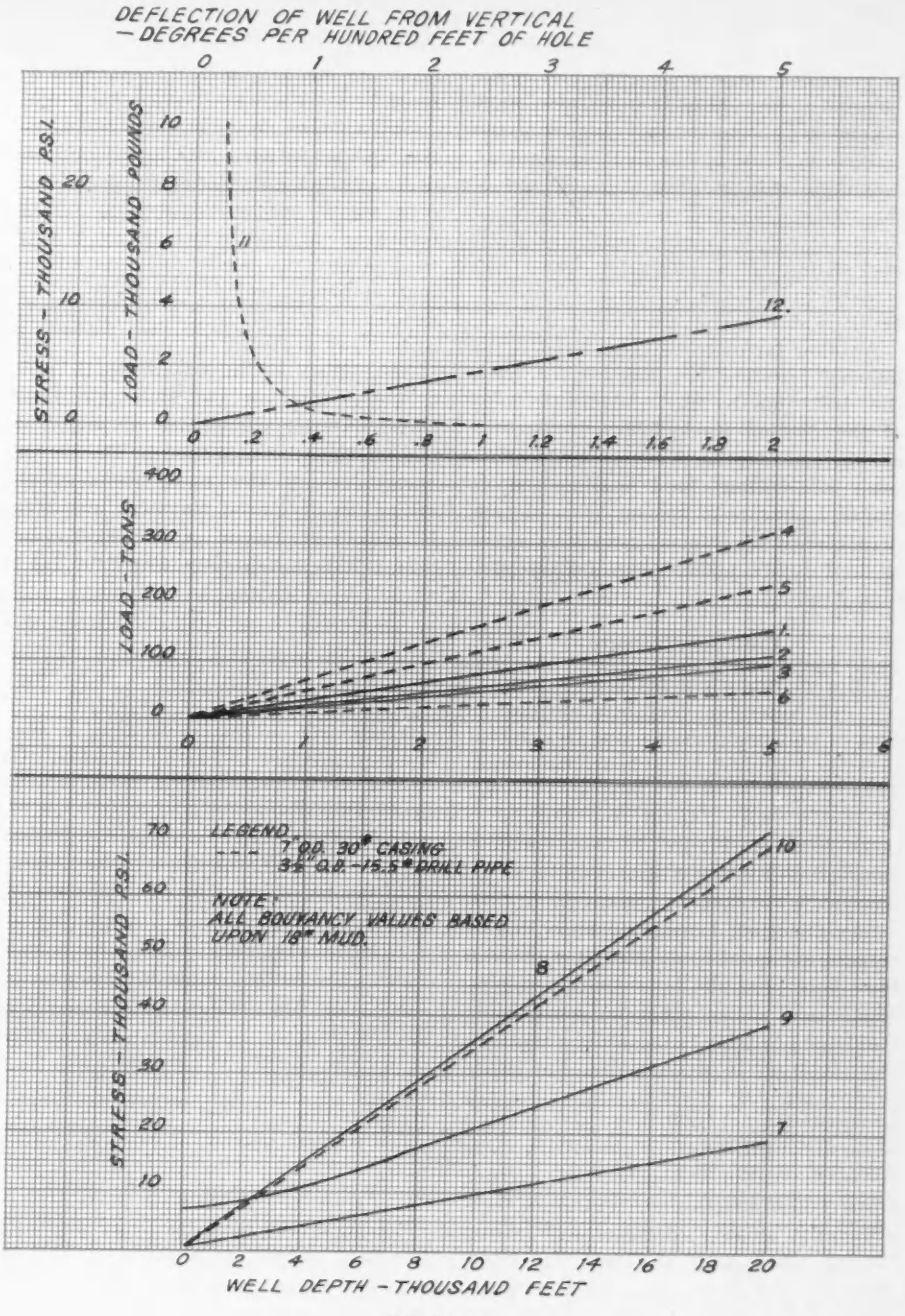

FIGURE 3

These dead loads are impressive as they represent the tensile load placed either upon the top joint of drill pipe or upon the kelly. The tensile stress decreases from a maximum value at the top joint to a tensile load equal to the weight of the bit on the lower joint. With these loads in mind it is evident that surface equipment must be able to handle any loads developed. As these loads are placed upon the hoisting apparatus or drawworks when raising and lowering the drill pipe, Curves 2 and 3 of Figure 3 were plotted to show the buoyant effect of the drilling fluid on the dead weight load of the drill pipe. These figures show the load is somewhat reduced but nevertheless is still of great magnitude. The significance of the problem is realized again when hard formations are encountered and is multiplied many-fold when they are encountered below 10,000 feet. This is demonstrated by studies of a well drilled recently in West Texas. In drilling through approximately 123 feet of chert, encountered at 11,457 feet, 148 rock bits were used, the bits averaging ten inches of hole, after which a round trip was necessary to change bits. Assuming 3½-inch drill pipe was being used, the dead weight represented approximately 182,000 pounds at 11,457 feet to 183,800 pounds at 11,580 feet. This load was raised out of the hole 148 times—an example which emphasizes the problems

involved in high tensile strain on drill pipe and wear on surface equipment due to excessive requirements in handling.

Long strings of drill pipe also have a tendency to elongate ranging from zero elongation at the bottom joint to maximum elongation at the top joint of the string. Elongations is a function of the total weight applied upon the drilling string. This elongation with increased weight due to increased drilling depth is shown in Curve 5, Figure 4.

Another factor to be considered is the internal bursting pressure placed upon the drill pipe by the hydrostatic head of the drilling fluid. Pressures exerted at various depths by the hydrostatic head of drilling fluid are shown in Curve 7, Figure 3. However, most failures caused by internal pressures occur in tool joints rather than in the drill pipe itself.

Collapse Pressure

Another important factor in considering drill pipe for deep-hole drilling is that of collapse pressure due to external pressures applied by subsurface formations. This has been illustrated in relationship with depth in Curves 1 through 6 of Figure 2 Deep drilling can be accomplished successfully in direct ratio to tensile strength of the string operated. Limiting factors in this respect are small hole diameter in deep bore holes and the long strings of pipe which necessarily must be used. Hole diameter probably is the most important consideration in determining the limits of drill pipe. By the time the driller has penetrated to 12,000 feet he must of necessity have had to reduce the hole to work within casing set to exclude water and to meet other conditions. Consequently, smaller diameter drill string having small wall thickness is necessary, thereby lessening tensile strength. Thus the safety factor rapidly approaches 1, which is considered by most operators as below the limit of safe drilling. Tapered strings consisting of larger diameter pipe in the upper portion and progressively decreasing smaller pipe to bottom somewhat compensate for this tensile loss factor, and generally consist of 4½-in OD on top and 3½-inch OD on bottom. Due to the threaded nature of drill pipe couplings and tool joints, the working yield strength and safety factor of the string are calculated on 80 percent of the minimum tensile strength. Curve 8, Figure 3, shows tensile stresses placed on drill pipe. Curve 9, Figure 3, shows combined tensile and torsion stress placed on drill pipe. It should be pointed out that regardless of the general trend of the curves, an ultimate safe rotary table speed is reached and thereafter severe torsion is placed on the drill pipe, which may cause failure. This ultimate speed varies with depth and type formation and it is general policy to decrease rotary table speed as hard formations are encountered.

Still another factor is the relative time the bit is on bottom with respect to total drilling time. This varies from 31.2 percent to 80 percent, depending on the following variables which are never identical in any two wells: (a) type of formation being drilled; (b) speed of rotation; (c) weight on bit; (d) condition of bit; (e) depth of drilling.

The effect of increased depth upon bit wear has not yet been correlated. However, the importance of such data cannot be overemphasized. The deeper the hole and the more frequent the round trips required, the more important becomes the factor of bit wear since hole can be made only when the bit is actually on bottom and turning.

Theoretically, drilling to 20,000 feet is possible while carrying a safety factor in excess of 1. But it must be remembered that drill pipe, regardless of strength and grade, is no better than the care with which it is handled. Its useful life is governed by the following general variables:

1. Capability and judgment of driller and crew.
2. Tendency of drill pipe to whip in hole.
3. Defects in pipe which may cause fatigue and failure while in use.
4. Corrosive elements which may be encountered.
5. Type of drill bit in use.
6. Speed of rotary table with respect to formations drilled.
7. Previous usage and condition of pipe.

Casing

Casing is the ultimate protection of a borehole and its correct size and weight must be determined with care. It is of welded or seamless construction, made of grades F-25, H-40, J-55, N-80 steel which have minimum yield strengths varying from 25,000 pounds per square inch to 80,000 pounds per square inch. It is available in many diameters, weights and lengths from 4½ to 20-inch OD; from 9.5 pounds to 90 pounds per foot, and in three lengths varying from 16 to more than 34 feet.

Casing stresses and strain differ from those imposed on drill pipe. Pipe must be designed to meet certain requirements such as bit clearance, hole clearance, amount of open hole carried, cementing procedures, mud weight and type of formation being drilled.

The principal stresses placed upon a column of casing and which determine casing design include: collapse stress, perhaps the most important factor to be considered; internal pressure stress; biaxial stress; compression stress in column loading; stress resulting from elongation; stress placed upon joints; abrasive wear from drill pipe.

Tensile stress enters into casing design primarily when running the casing into the hole. Variation in the deadweight load of a casing string with relative depth is shown in Curve 4, Figure 3. Curve 5, Figure 3, shows the buoyant effect of drilling mud on a casing string. Relative elongation of casing with reference to depth and weight of drilling fluid is shown in Curve 5, Figure 4.

The temperature factor also must be considered in the tensile loading of casing. Casing may be subjected to the temperature of cold drilling fluid when, for example, the plug on the oil string is being drilled or when drilling is being carried through an intermediate string. An increase in the average temperature decreases the load, and conversely, upon decreasing the average temperature the tensile load will increase. Curves 1 and 2, Figure 4, show the percent increase or decrease in load with corresponding changes in temperature for a casing string at a depth of 5,000 and 20,000 feet. Although these curves apply to a definite diameter and weight of casing, they apply with sufficient accuracy to any diameter and weight at a given depth.

The most important factor to be considered in casing design is that of failure by collapse which may result from: (a) formation pressure; (b) squeeze cementing; (c) head of drilling fluid; (d) gas pressure. Curve 7, Figure 3, shows pressure resulting from a head of fluid. Formation pressures usually resulting from high pressure gas tend to complicate the problem of collapse, particularly in the case of tapered strings (where heavier weight of casing is used in upper and lower portions). Curves 1 through 6, Figure 2, show the values of pressure exerted at varying depths.

Under normal operating conditions internal or bursting pressure is not a difficult problem in casing design. However, under severe pressures exerted in squeeze cementing or when the string is carrying high-pressure gas and is closed at bottom by a cement plug, a large pressure differential may occur between the inside and outside of the casing. When this differential exceeds the critical point, the casing will fail.

Câsing failure as a result of biaxial stresses exerted at changeover joints in tapered strings becomes increasingly possible with the setting of casing at greater depths. Various weights of the same pipe usually are made up of grades N-80 and J-55. Grade N-80 is used in the upper portion for greater tensile resistance; Grade J-55 is used in the central portion for decreased weight and Grade N-80 is used in the lower portion for greater collapse resistance. Where two or more weights of casing are used,

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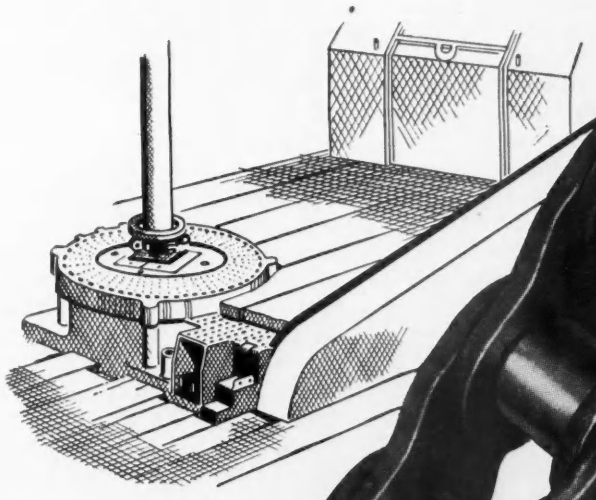

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two points of decreased resistance are created, these being the two change-over couplings. This is significant and many of the deeper casing failures have originated in a coupling leak. Well depth places a limiting factor of resistance as it governs the tensile load placed upon these couplings.

The factor of failure by compression or column loading of a string of casing is the next consideration. When casing is set on bottom and is not supported, or is only partly supported at the upper end, there is a possibility of failure by buckling under excessive column loading. Under such conditions, if caving or erosion of the walls of the bore hole has caused a cavity so that the pipe is not supported by the walls, it must function as a column in supporting the weight of the pipe above. The column strength of casing increases rapidly with increase in diameter and, for a given diameter, is approximately proportional to the weight. Casing columns extending to the surface are commonly supported from their upper ends so that they are maintained under tension and buckling due to column action can not occur. But where this practice is not followed or where insufficient tension is taken at the casinghead to support the full weight of the column, failure may occur wherever the walls of the well fail to provide adequate support. Casing is believed to have no strength in compression unless supported by the walls of the hole. Liners often are subjected to column loading when resting on bottom. Curve 11, Figure 3, shows the strength of casing as a liner under column loading at various depths. This curve shows the relatively small lengths of pipe that may safely be set without wall support. When oil is being produced, column failure may occur due to the temperature rise actuated by the flow of hot oil in the annular space between the tubing and the oil string, this failure resulting from expansion of the casing string.

Bending stress of casing is a factor that must be considered. This indirectly is a function of stress imposed upon the joints and couplings, as casing string failures under bending loads usually occur by pulling out the threaded joints in the couplings. This bending stress, sufficient to cause distortion of the string, may occur either in a crooked hole where the casing must perforce adapt itself to changes in the direction of the hole, or where bulging or caving is present in the hole thereby imposing lateral stresses upon the casing column. Curve 12, Figure 3, indicates the stress placed upon casing at various angles of deflection of the hole from vertical per 100 feet of length.

Where corrosive agents are present in a bore hole, corrosion will occur regardless of depth. Deep holes merely intensify the results which indirectly are the origin of different types of casing failures due to greater loads and stresses imposed.

Safety Factors

One of the governing problems confronting deep drilling is that of maintaining a sufficient safety factor when setting casing.

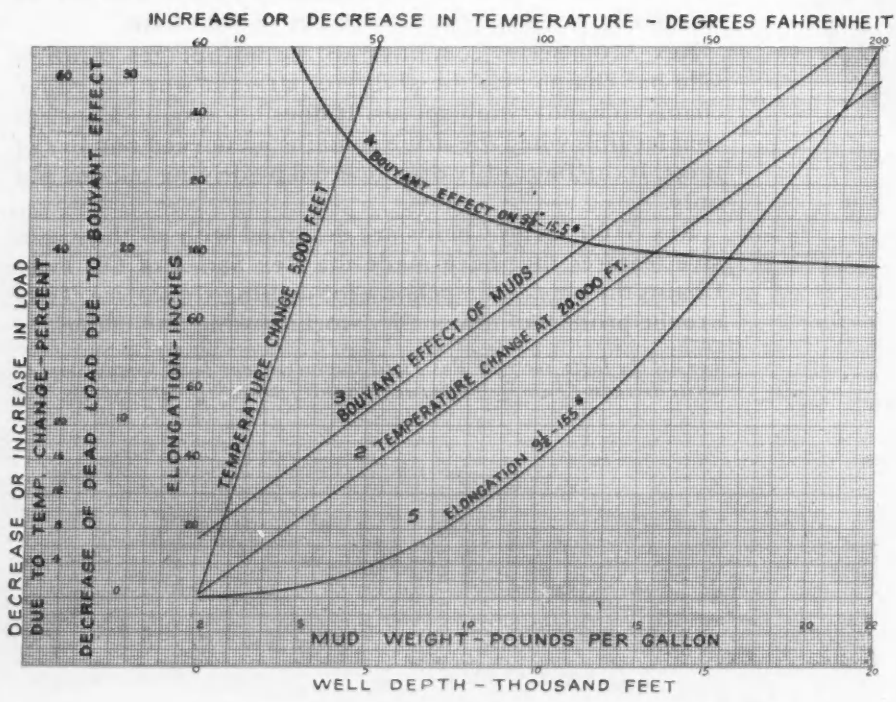
The general practice is to use a somewhat greater safety factor than is carried for drill pipe, since pipe is set permanently and cannot be inspected periodically for signs of wear and fatigue as can drill pipe. By increasing the safety factor, the depth to which casing may be safely set is decreased. For this reason safety factors are based on different minimum yield properties of the pipe. The safety factor when based on the minimum yield strength in collapse may be as low as 1.25. Assuming this, seven-inch OD, 38-pound, Grade N-80 casing may be set below 16,000 feet.

If based on allowable longitudinal tensile stress and joint strength, it is deemed wise to carry a safety factor of 1.8 to 2. On this assumption, seven-inch OD, 38-pound, Grade N-80 casing may be set below 15,000 feet. In fact, such a string has been safely landed at 16,351 feet.

Safety factors apply principally to the oil and intermediate strings. Drill pipe will tend to wear the intermediate string with maximum wear occurring from 100 to 200 feet below the surface of the well. This will definitely decrease the strength of the string. Sometimes it is advisable to carry the intermediate string to considerable depth and therefore the design problem is important. Equally important is the design of the oil string and, although this is not subjected to drill pipe wear, it must withstand temperature and pressure changes caused by the oil flow.

Casing, like drill pipe, is no better than its construction, use and care. Theoretically, all casing is equal to the limits imposed by API specifications. In addition, manufacturers include safety factors designed to maintain a safe limit of load. However, failure before the safety factor is reached may be caused by: (a) defective material; (b) construction defects; (c) lamination caused by improper use of slips and makeup equipment; (d) failure of threaded couplings; (e) excessive pressure in mill testing; (f) lack of care in handling; (g) poor judgment in setting practices.

Despite current and future problems involved in the drilling of deep wells, engineers and others who figure in such operations are confident that wells eventually will be completed at 20,000 feet or even deeper. New drilling practices are being evolved while better steel alloys designed to increase drill stem and casing strengths are being developed. Upset casing is now being manufactured designed to allow increased setting depths with present weights. In effect, the progress made in deep hole drilling during the past few years provides the industry the hope that in due time the technique will be developed to a point where the deep hole will be as routine as the shallow hole is today.


INCREASE OR DECREASE IN TEMPERATURE - DEGREES FAHRENHEIT
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ELONGATION - INCHES
4 BOUYANT EFFECT ON 9⅝" - 15.5#
TEMPERATURE CHANGE 5000 FEET
3 BOUYANT EFFECT OF MUDS
2 TEMPERATURE CHANGE AT 20,000 FT.
5 ELONGATION 9⅝" - 15.5#
MUD WEIGHT - POUNDS PER GALLON
WELL DEPTH - THOUSAND FEET

FIGURE 4

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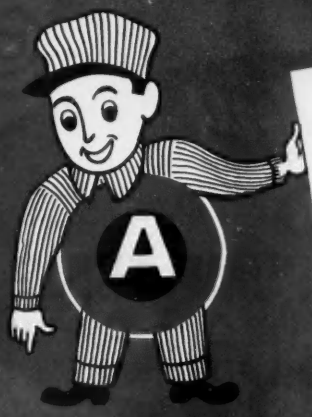
[1] Cooley, Herbert M. "Casing and Wire Rope—A Look at the Future," *The Oil Weekly*, May 12, 1947, p. 42.

[2] "Abnormal Pressures on Gulf Coast," Petroleum Technology, 1st quarter, 1946.



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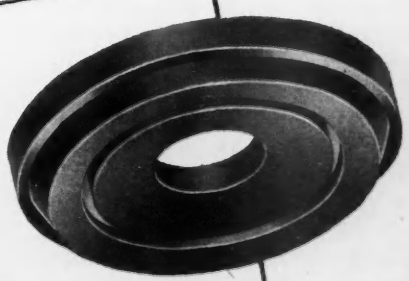

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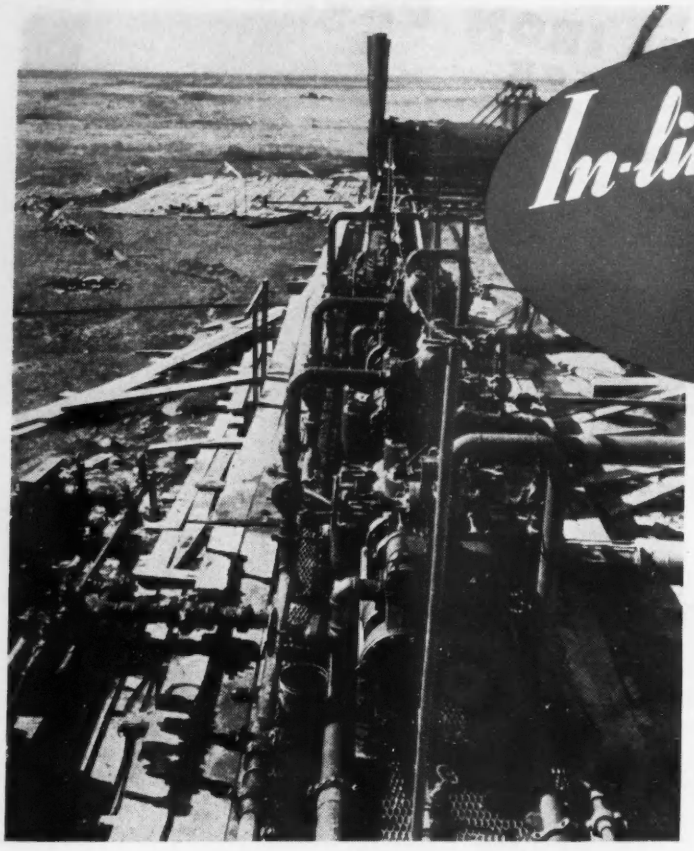

In-line Mounting SIMPLIFIES PUMP SETUP AND PIPING

by

M. H. PEARCE
Engineer

SIMPLIFIED piping and setup are means for bettering mud pump efficiency and reducing lost time at the rig. A change from what might be termed "parallel" to "series" setting automatically aligns units and provides fullest flexibility of output.

FIGURE 1. Three identical pumps, set in line on narrow, interlocking skids, tie directly into common steam, exhaust, mud and water lines with a minimum of pipe, connections and confusion.

PROBABLY because of the location of the suction opening in the end of the fluid section casting, it appears to be common practice to set the mud pumps up so that their center lines are at right angles to mud, steam and water lines. This arrangement requires considerable width for the pump setting, as space must be left around each unit to permit the usual maintenance work to be carried on without being crowded by units still putting up pressure.

One contractor abandoned the standard procedure for an "in-line" setup with the pumps in a row on relatively narrow skids. Two of the pumps are set on one skid, which then is as long as may be hauled conveniently. Apart from being on a single skid, however, the pumps are completely separate insofar as operation is concerned. The third pump is mounted on a skid of the same width and depth, but only half the length of the one mounting dual pumps. Both skids are provided with ends which interlock, so that the single-pump skid may be attached either ahead of or behind the dual unit.

Standardized Skid Piping

The piping is standardized on all skids. At the extreme right, facing along the skid from boiler toward rig, is placed the mud line. Second is the exhaust steam line, which carries all waste steam back to the feedwater heater at the boiler setting. Through the center of the skids is carried the fresh water line. Next is the steam line, which carries steam not only to the pumps, but also to the drawworks engine on the rig. The fifth pipe is a return mud circulation line, so that pressure from any unit in operation may be used to prime the suction of a unit closer to the boilers. Regardless of which skid is set nearer the boilers, the two present the various pipe lines in the same sequence, so that no accidental interchange is possible.

The five lines are so measured and equipped with unions at the ends of both skids that regardless of sequence, the same short connection "sub" will serve to bridge the gap. As the subs are of different lengths, as well as varying somewhat in diameter, it is impossible to attempt to connect up lines or unions which do not mate.

Pump suctions are longer than when the end-on method of connecting is used. Under the in-line system, the suction is tied in to the pump on the end and away from the mud pits, is brought around in a full 90-degree sweep turn to cross beyond the end of the pump, and then is connected through quick-acting union and short hose to the usual suction line. This method of mounting allows the sweep and transverse pipe to be rigidly mounted on the skid. When so set, the pump casting is relieved of vibrational and torsional stresses sometimes sustained when the suction is carried directly on the fluid-end casting.

Except for the fresh-water line, all the others lie outside the pump bodies, and may be removed or replaced without disturbing the pump setup. Each line is carried on formed supports which are welded to cross members of the skids. Pipe of the same diameter as that carried is used for supports, being cut to form a cradle for the line laid in it. For the larger lines, a 1¼-inch hole is drilled through the support, at right angles to the axis of the cradle. A steel pin, formed from 1-7/32-inch steel shafting, is cut to extend through the support about 1¼ inches on each side. A ¾-inch hole through this pin, placed so as to fall outside each wall of the support, accommodates a U-bolt which is slipped over the pipe and pulled tight with nuts below the cross pin. The U-bolts are placed in pairs, so that each pulls against a fitting and the two exert a stabilizing pull which holds the line against possible end shifts. The supports are spotted on the skids so as to be directly under branch lines and thus take the weight of valves or other fittings.

Normally, all piping is cut at the unions at skid ends when the units are to be moved and the short connection subs between skids are removed. No other connections need be disturbed to permit the entire pump setup to be loaded and reset at the next location. Sockets, consisting of half collars, are

welded to skid cross members at the ends of the pumps to take the eight-foot standards of two-inch pipe which carry the lighting fixtures and leads which serve rig as well as pumps.

Timber cribbing is used to support and align the skids, the timber cross pieces being allowed to extend on either side of the skids. These extensions carry either two or three 2x10's to form walkways. Expanded metal flooring fills the space between the tops of the longitudinal beams forming the sides of the skids. It is tack-welded at intervals to prevent shifting or possible crimping to form hazards.

Arrangement of the valves in the mud lines and in the return circulation loop enable the driller to compound two units, or even to step up pressure through three stages, simply by proper valve settings. Also, of course, it is possible to put through a high mud volume by tying all three pumps directly into the mud discharge line. Through the interchangeable feature of the two skids, one pump is set up on a given location as the "low pressure" unit. That is, it is nearest the boilers, and cannot be used as high-pressure stage because it is first in line on the mud discharge. But, on the next location, this pump is set (simply by shifting skid arrangement) nearest the rig, and thus becomes the high-pressure unit when compounded. Under the set-up, any of the three pumps may be idle without affecting the operation of the other two, whether compounded or working in parallel.

Killing Pump Setup

The pump setup described is on a workover rig. The rig, however, has drilled to below 10,000 feet from grass roots on the Upper Gulf Coast, and the plan presents no difficulties which would prevent its use with heavier equipment to extend the depth range of possible drilling. As a further safegrard, especially on workover operations where high gas pressures are known to exist in combination with production zone pressures, a separate "killing" pump setup is provided. This consists of two cementing-type pumps, mounted on a skid so that they may be operated in parallel or series. They normally take mud under high pressures from the mid discharge line of the slush-pump system, and then are capable of putting up pressures in the range of 4500 pounds per square inch. They may also, in the event the entire mud system is down, take fresh water from the main at boiler-feed pump pressures and step it up to a value high enough to overcome reservoir pressures.

To simplify piping and connection work, only mud, water and steam are tied to the "killing" pump from the slush pump skid lines, steam being wasted on the rare occasions when the special unit is operated.

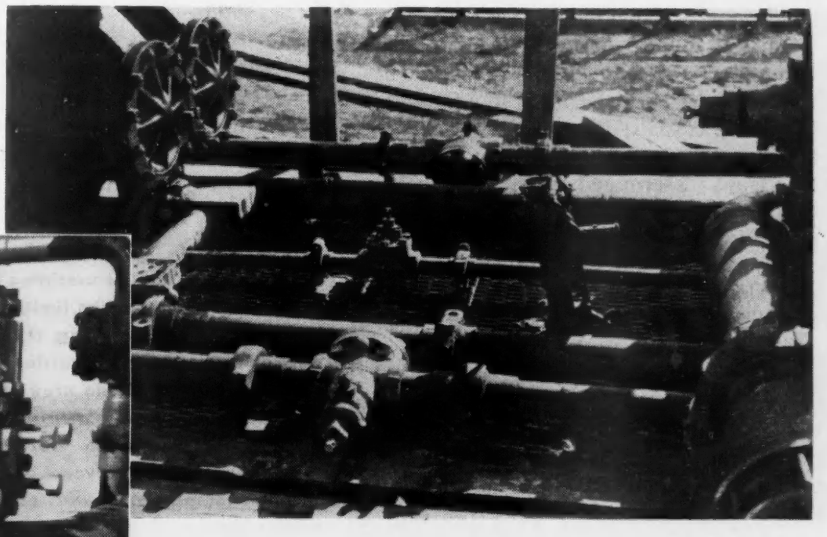

FIGURE 2 (right) Special "pup" connection joints are used between skids. These are of various lengths and diameters, and are equipped with different types of unions so they can be used only in their proper places. The mains terminate in exactly the same pattern at opposite skid ends to facilitate alternating pumps at high- and low-pressure stations.

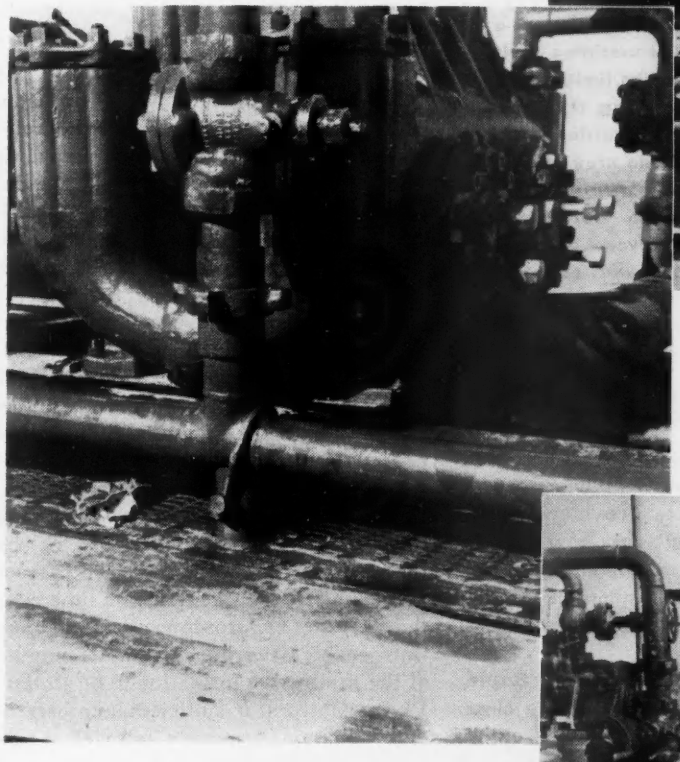

FIGURE 3 (left) Special cradle which is used to support each line, with U-bolt to clamp pipe down and prevent endwise shift. The pin through which the U-bolt passes can turn in the pedestal to align pull directly against riser in Tee.

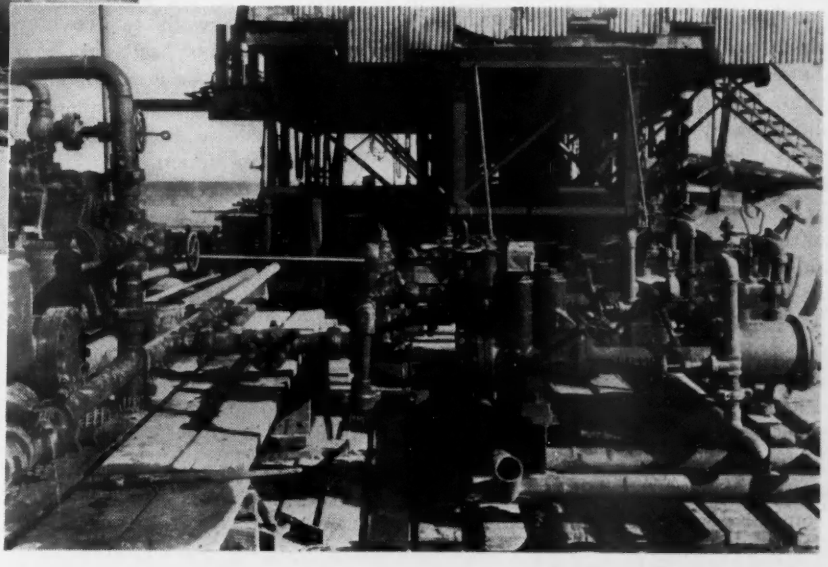

FIGURE 4 (right) Two cementing pumps are tied into rig mud line to build up extremely high pressures for killing a well or combating high-pressure gas. Taking mud from the slush pumps' discharge line or water from the boiler feedwater system, the "killing" unit can put up 4500-pound heads for BOP or annulus operations.

TRACING WILDCAT TRENDS WITH Radon Emanations

By R. A. STOTHART
Radioactive Serveys Company

RADON emanation determination, proved in many areas as an effective means for determining the trend of the pay after one or more producing wells had been completed in an area,[1] appeared for a time after the Alamogordo, Nagasaki and Bikini atomic bomb detonations to have been an innocent bystander and likewise a casualty. Surveys of these explosions failed to check with expected results as determined from previously conducted radon measurements in the same or similar areas. The apparent elimination of this method of supplemental surveying for production seemed complete when check surveys were run over areas which had been previously surveyed, and in which the results of drilling closely corroborated the indications of the previous emanation evaluation. There was no relation between the earlier surveys and the later runs, except that in most instances the last-run surveys showed a much higher degree of radioactivity than had the earlier determinations.

Further experimentation showed that the increased radioactivity, presumably due to after-effects of the atomic bomb detonations, was not uniform over any special region, but was spotty, with areas which had no apparent change in radon characteristics abutting those with uniform, high readings. The new surveys also showed a high degree of uniformity of readings over these spotty areas, whereas an outstanding feature of the method as originally developed was the extreme sensitivity of the electroscopes and their consequent indication of minute changes in intensity.

When it was suspected that the excessive readings were a surface function only, a technique was worked out to bypass the difficulty successfully. It involved the use of two augers for making the test hole instead of one. The first, used to get below the surface and away from the possible effects of the "shower" of radioactive particles, was used for this purpose only and a second bit used to clean out down to the desired depth. Tests run over areas with prewar radon surveys showed that the revision of procedure had eliminated the surface showings derived from atomic bomb after-effects, and that subsurface conditions still were an accurate reflection of the emanations originating far below the surface.

RADON EMANATIONS, effective as a check method for determining fault trends and productivity limits, offer a means for determining the most desirable areas for wildcatting when known production in an area affords a correlation base. Cross-gridding an area with emanation determinations will indicate favorable areas through comparable trends on intersecting surveys.

Extension of the earlier uses of radon emanation surveys in areas where there are sufficient wells to provide a background or grid of basic data now enables the method to be used for carrying out check surveys to determine the probability of wildcat success between known areas of production.

On the Upper Gulf Coast, for example, where there are wells on relatively close spacing over large areas or even entire counties, and where there are sufficient producing wells among the number to establish radon-time relations for the area, it is possible to run surveys out radially from each well and to plot the variation in readings. These readings, when correlated with a second, intersecting set from another producer, within a distance of about ten miles, provide a means for ascertaining the changes in determinations which can be used to delimit shoreline conditions too low in relief to be accurately outlined by seismographic or other geophysical survey methods. A series of such intersecting traverses, utilizing dry-hole data when these tests have penetrated to formations productive in adjacent commercial wells, develop indications which when interpreted in the light of past experience, indicate the areas best suited to actual exploration with the drill.

Technique for Proven Fields

The method for determining probable extensions of existing fields,[2] or the trend of production in the shoestring sands typical of Kansas fields, involves the determination of the radon characteristics at the nearest producing well, and the extension of readings on lines at 90 degrees or more until the time factor shows a sharp increase over that characterizing production. It is determined, from earlier surveys and the experience which comes with practice, that this sharp jump in time may be directly correlated with the discontinuity of the producing zone. The break, whether occasioned by water intrusion, as occurs on down-the-slope determinations, or by the pinchout of the zone in the case of shoreline structures, alters the time relation of the electroscope readings and thus enables the approximate contours of the productive formation to be plotted. Plotting errors, if sufficient numbers of determinations are made, fall well within the probable variation of the well bore in drilling to production for what—on the survey—would appear to be an edge location.

In the determination of probable production trend over a deep-seated salt dome, where previous experience has indicated that the disturbance of producing formations by the salt plug intrusion will render adjacent areas either dry or

productive, radon surveys have enabled operators to choose between possible well sites. Such choice, especially in seeking production a mile or more in depth, can quickly make the difference between profitable exploitation and serious loss.

A typical deep salt dome area is the Thompson field, Fort Bend County, Texas. Here radon emanation surveys, in advance of drill-stem operations, developed a surface map of probable locations which showed remarkably close correlation with the actual drilled locations of producers over a period of more than seven years. Comparison of the survey shown in Figure 1 with the locations of productive and dry holes on the field map appearing as Figure 2 develops the fact that all holes drilled within the area in which the survey readings were in the range of 1 to 1:50 or approximately that of the discovery well made producers, while those in which high readings show on the radon survey turned out dry or went to salt water without making profitable producers.

By working from a basis such as that supplied by the discovery well of the Thompson field, and carrying surveys radiating outward from this center, it would be possible to obtain determinations of radon emanation activity which would enable the operator to plot changes in underground conditions. The securing of a set of such plotted changes, in account with other known data from the subsurface conditions as determined by other survey methods, offers a basis for checking a second survey, emanating from another known productive area in the same formation and thus determining the most advantageous site for a test hole to determine possible production as an extension of the conditions which made the base wells commercially profitable.

It is not advocated that a well be drilled on the showing of such survey correlation alone, or that a well be drilled because a survey shows a set of readings which match closely those of another productive area. However, it is suggested that the change marked by such surveys be relied upon to indicate the extent that such change be checked with those shown by other methods, and evidence thus obtained be used by the geologist as an aid to future exploration developments.

The survey method uses the same principle of emanation-time control for delimiting within close margins the trend of a fault when such is known to exist within an area, or even if a fault is suspected through indications derived from other means.[3] The securing of a survey along one side of the suspected fault, when compared with a second survey across the break, not only will indicate the trend of such fault, but usually will indicate deviation from the known or supposed trend in instances where the principal fault is broken or distorted by a cross break. This determination of fault trend, when correlated with geological information concerning the productive potentialities of the upthrow and downthrow sides of the fault, thus will enable the wildcatter to classify the area and thus avoid loss through drilling into the less favorable of the two sides of the fault zone.

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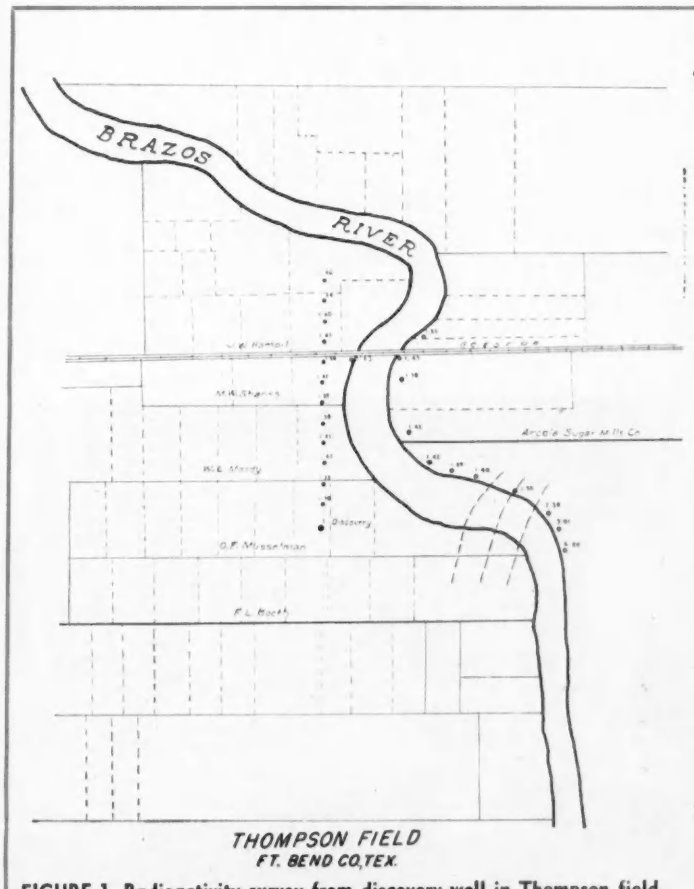

FIGURE 1. Radioactivity survey from discovery well in Thompson field, Texas, run when only well in area was that which proved production. Readings taken indicate production throughout northward line, with dry holes to right of river beyond the indicated fault.

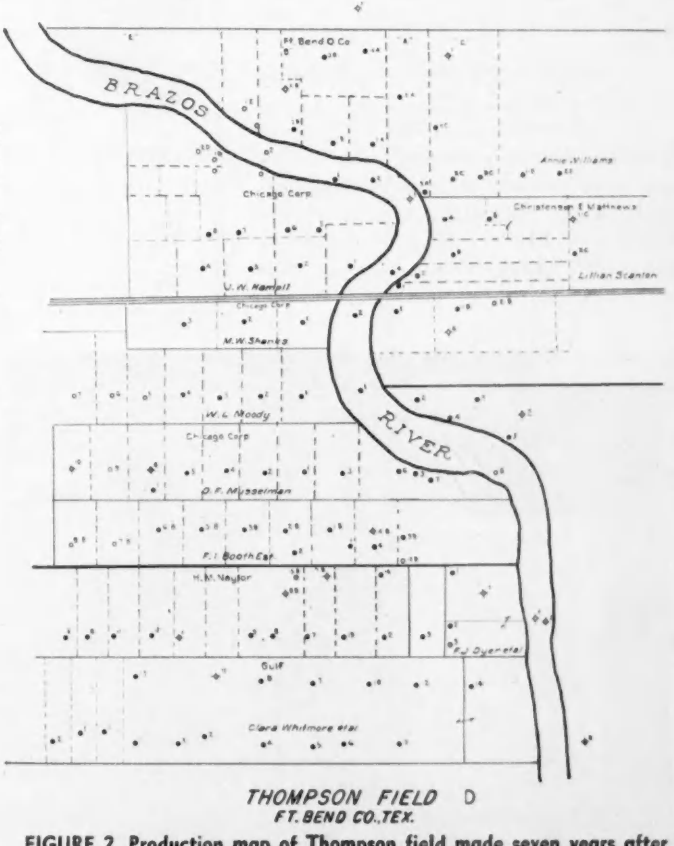

FIGURE 2. Production map of Thompson field made seven years after Figure 1. Comparison with original survey emphasizes close correlation of production northward and eastward as indicated by radon emanations observed. Dry holes east of Musselman lease were as predicted by early survey.

PORTABLE *Well Logging* UNIT

A PORTABLE electric well logging unit has found successful application in the Mid-Continent areas of Kansas, Oklahoma and Texas. It is used extensively in logging core holes, seismograph shot holes and water wells where conventional electrolog is uneconomical.

By WILFRED TAPPER,
General Manager, Electrical Well Services, Halliburton Oil Well Cementing Company

IN THE past, a great deal of geological information has been lost because of the expense of the conventional electric log. Logs on core holes, seismograph shot holes, and on water wells would have proved valuable, but at the time of drilling the expense of an electric log did not seem justified. In an attempt to meet this need, a portable unit has been developed. This logging unit has three principal parts: (1) An instrument and recording tray measuring 19¾ x 15½ x 14¼ inches, and weighing 50 pounds; (2) a conventional measuring system measuring 30 x 14 x 10¼ inches, and weighing 50 pounds; (3) a self-powered winch with a maximum of 3000 feet of cable measuring 40 x 33 x 36 inches with a total weight of 1000 pounds.

The complete unit without the reel is shown in Figure 2.

The instrument panel can be operated by non-technical personnel after a few lessons. Untrained field personnel have operated the unit after reading the instruction manual. Figure 1 shows the instrument panel, with a total of only five switches to be operated, i.e., (1) off-on switch; (2) master base switch; (3) Vernier base switch; (4) scale per inch switch; (5) selector switch. All switches are set prior to logging, and no changes are necessary after the logging operation is started.

The electrical power for the recording unit is supplied by a standard six-volt storage battery, the current drain at full load being approximately three amperes.

The measuring and recorder drive equipment consists of an accurately ground measuring sheave, a frame for mounting the sheave over the well, and a flexible cable with fittings which drive the recorder and keep the chart synchronized with respect to depth.

The cable which is used to raise and lower the electrode in the hole is the standard 5/16-inch, steel armored, helically wrapped, single conductor, logging cable.

The portable logging unit was designed to record three basic curves: (1) a potential curve; (2) a single-point impedance curve; and (3) a caliper curve. These are not recorded simultaneously, but must be made on separate trips. When a caliper log is made, the caliper tool is substituted for the regular logging electrode.

A conventional log, as shown in Figure 3, is obtained. The curves are recorded directly on a paper chart by use of a stylus recorder. This recorder is coupled to, and driven by, a calibrated measuring sheave which provides the system with accurate depth measurements. The unit is so arranged that a

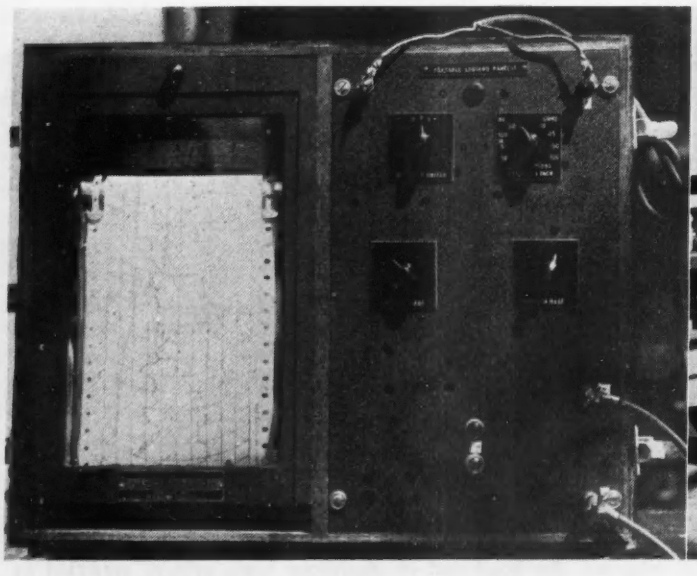

FIGURE 1. Combination unit carries the control panel and the chart on which the curve sought is recorded. Standard 50 feet of hole per inch scale is used, and curve drawn may be either of those provided in scope of instrument.

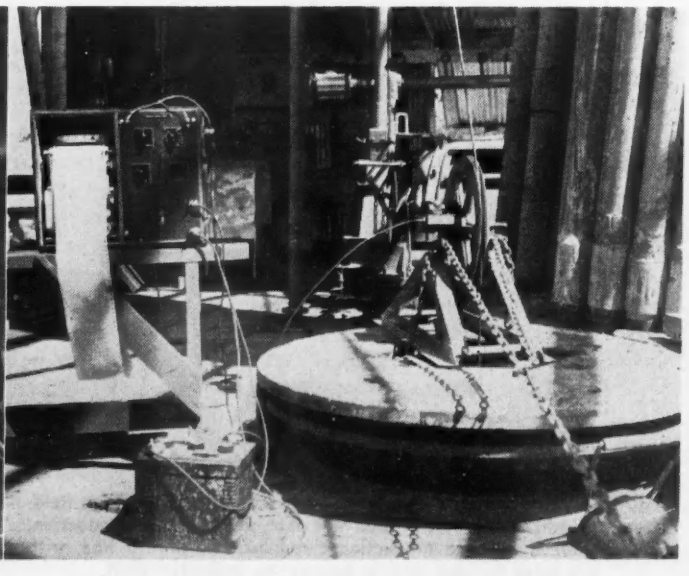

FIGURE 2. Method of mounting portable logging unit for well survey, with measuring reel and shaft drive to chart mechanism. One six-volt battery powers the electrical end of the unit, keeping it independent of rig or outside current.

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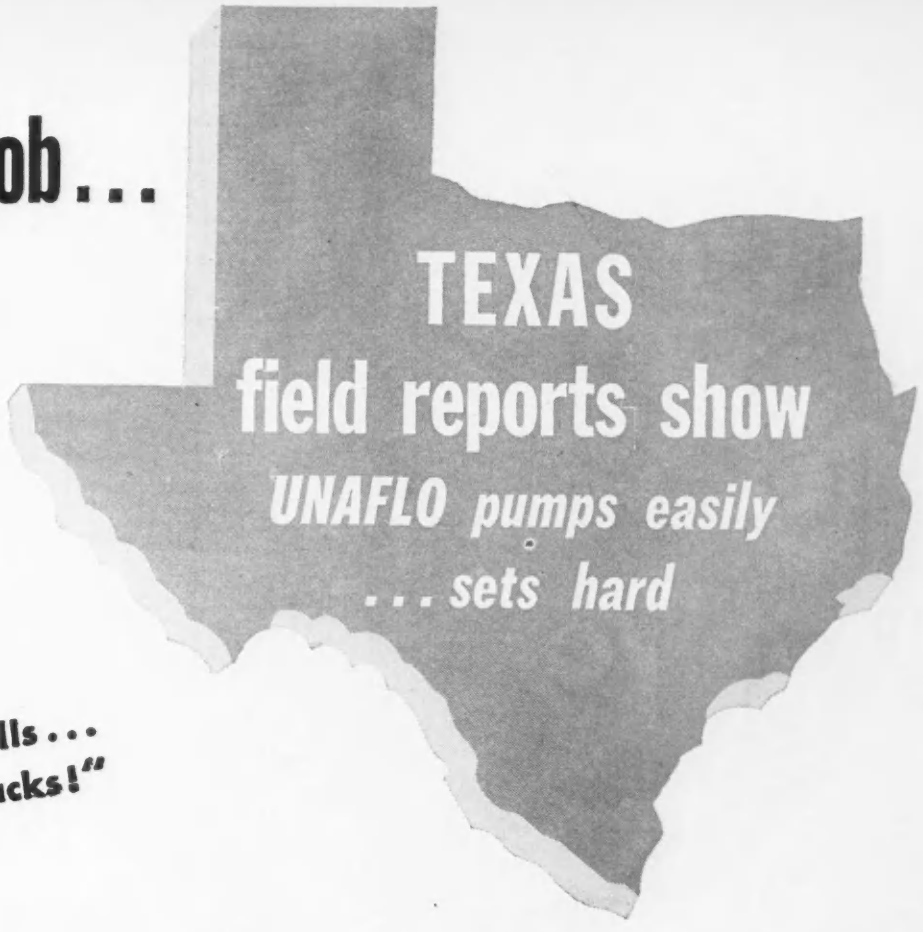

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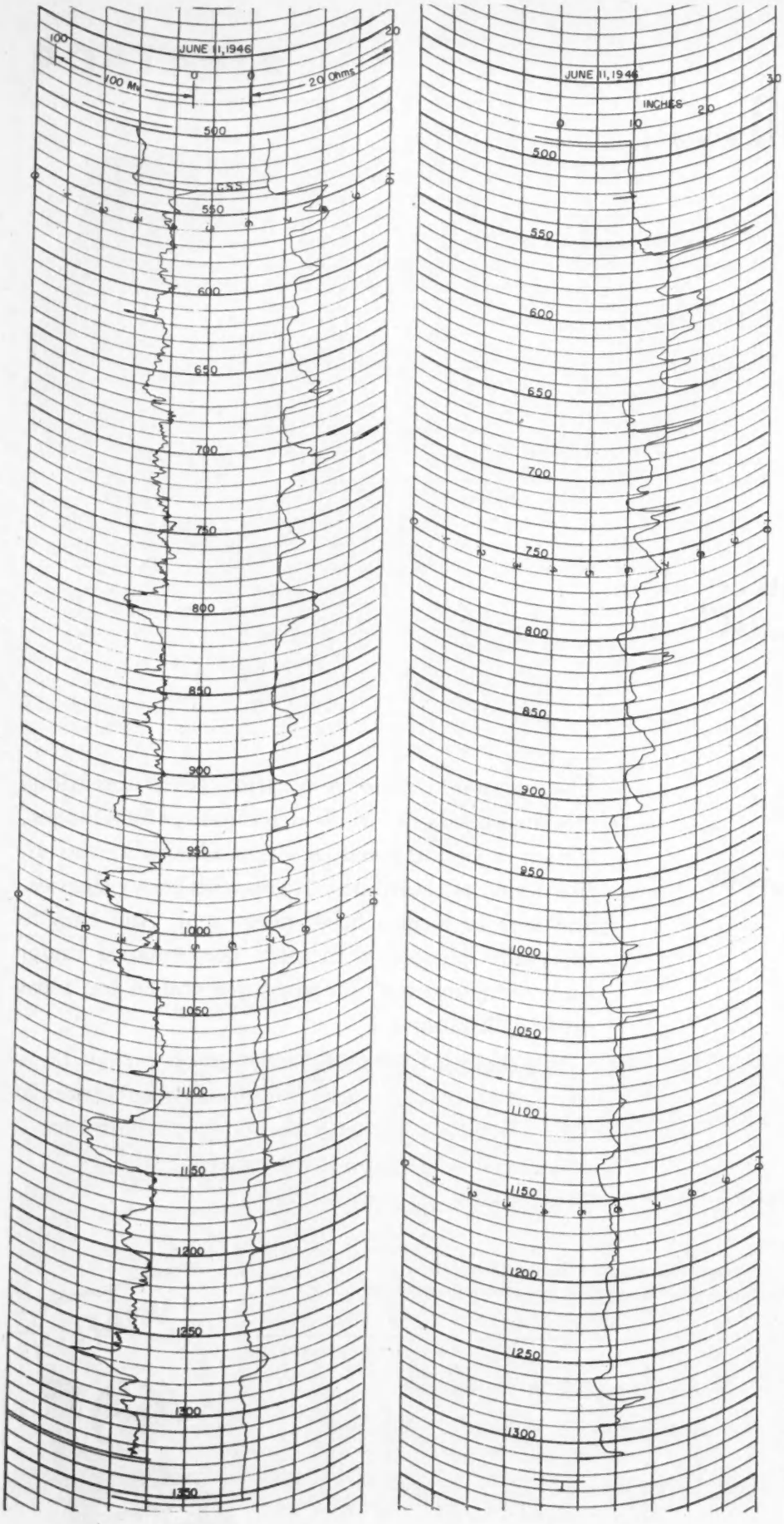

FIGURE 3. Typical curves produced on portable unit, showing readily identifiable characteristics and sensitivity of instrument.

full-scale meter swing of each of the curves is two inches. The caliper log is arranged so that it is recorded in much the same manner as the impedance curve, with the exception that the full-scale meter swing is three inches.

In an effort to keep the design as simple as compatible with good logging technique, a limited number of sensitivities were provided. Two sensitivites can be obtaned for the potential, five for the impedance, and two for the caliper log. These are measured in inches of deflection, and are as follows:

Potential

50 mv. per inch or 100 mv. full scale
100 mv. per inch or 200 mv. full scale

Impedance

10 ohms per inch or 20 ohms full scale
25 ohms per inch or 50 ohms full scale
50 ohms per inch or 100 ohms full scale
100 ohms per inch or 200 ohms full scale
150 ohms per inch or 300 ohms full scale

Caliper

5 inches per inch or 15 inches full scale
10 inches per inch or 30 inches full scale

There are certain limitations inherent in a portable logging system. The fact that the apparatus must be extremely simple, light weight, and inexpensive necessitates the sacrifice of many characteristics of larger logging systems.

Inasmuch as one of the primary uses of the unit is for correlation work, there are no provisions made for obtaining spaced curves. To obtain subsidiary curves would mean the construction of larger and more expensive equipment.

It is possible to log only one curve at a time. Again, a sacrifice was made for the sake of simplicity. This disadvantage is partially offset by the speed at which the log can be run.

Only one depth scale is available at present. The scale of one inch per 50 feet of hole was used, since this scale is universally used, and seems to provide the maximum amount of detail and correlation.

Engineers recognize that the portable logging unit has definite limitations but its application in the field has proved it to be a valuable addition to the tools of the oil industry. The inherent limitations in the unit could be overcome but to do so would defeat the original purposes for which it was designed, namely, economy and portability.

ACKNOWLEDGMENTS

The writer is indebted to H. C. Waters and J. K. Reynolds of Halliburton Oil Well Cementing Company for suggestions and advice, and to Halliburton Oil Well Cementing Company for permission to publish this article.

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Electrical Logging Developments in the U.S.S.R.

Part 3

The Equivalence Principle

By HUBERT GUYOD
Well-Logging Consultant, Houston

IN THIS article the following notations will be used:

R, resistivity of formation not invaded by mud;
R_i, resistivity of same formation when entirely invaded by mud;
R_w, resistivity of interstitial water of formation;
R_m, mud resistivity;
R_a, apparent resistivity of formation;
d, hole diameter;
D, diameter of mud-invaded zone;
Sp, electrode spacing.
Numbers in brackets denote respectively [D/d, R_i/R_m, R/R_m].

The formations concerned are assumed to be very thick (thickness greater than at least five times the maximum electrode spacing used) in order that the departure curves previously discussed apply without correction.

The departure curve data correspond to average apparent resistivities obtained near the center of the bed, namely at distances from the bed boundaries not less than the length of the maximum electrode spacing used:

The boundary between invaded zone and non-invaded zone is supposed to be sharp even if this is not the case in practice, on the strength of a discussion offered in the preceding article.

The Equivalence Principle

If we plot on the same grid a number of departure curves for which the quantity R/R_m is the same, but the factors D/d and R_i/R_m are different, it is seen that the curves fit in surprisingly well. This is illustrated by Figures 18 and 19 which represent a few departure curves for two-electrode and three-electrode arrangements, respectively.

The fit is excellent when the factors D/d and R_i/R_m remain within certain limits, for example when the ratio D/d is comprised between 1.2 and 4.

The figure shows that an invaded zone of resistivity R_i and diameter D is equivalent to an invaded zone of resistivity greater than R_i but of diameter smaller than D. The electrical effect of these two media is the same.

For the particular case where the formation resistivity R equals the mud resistivity R_m, L. M. Alpin has established the conditions which must be fulfilled in order that the departure curves pertaining to two or more invaded media be identical. These conditions are as follows:

1. The resistivity R_i of the mud invaded zone must be greater than R and greater than R_m for all the media concerned.

2. The value of the quantity

$$U = (R_i/R_m - 1) \ln D/d$$

must also be the same for these media.

U is called the equivalent number.

3. D/d must be comprised between 1.2 and 4.

The foregoing theorem is only approximate, but the approximation is very close when the numerical value of ratio D/d remains between 1.2 and 4. This is illustrated by Table 1, which gives several values of the apparent resistivity contrast R_a/R_m for two media having respectively the following characteristics: [1.5, 33.48, 1] and [2, 20, 1]. The match is excellent, even for low values and for high values of Sp/d, because the characteristics of the invaded zone of the two beds concerned are not too different. The match would not be as good, especially for small and large values of Sp/d, if the difference between these characteristics were much greater.

TABLE 1
Comparison of Apparent Resistivity of Two Mud-Invaded Beds Having the Same Equivalent Number (U = 13.17)

Sp/d	Two-Electrode Arrangement [1.5, 33.48, 1]	[2, 20, 1]	Three-Electrode Arrangement [1.5, 33.48, 1]	[2, 20, 1]
0.15	2.072	2.063	1.027	1.026
0.31	3.067	3.051	1.197	1.192
0.61	4.629	4.611	2.140	2.115
1.23	6.021	6.017	5.044	4.987
2.45	5.342	5.379	8.389	8.389
4.91	2.607	2.641	6.321	6.406
9.82	1.160	1.153	1.820	1.817
19.6	1.000	1.010	1.000	1.030

Equivalent Charts

The equivalence principle summarized above permits using, for a given resistivity distribution, a departure curve already established for a different distribution. In practice it is convenient to use departure charts calibrated as a function of the equivalent number U, such as those shown on Figures 20 and 21. Figure 20 is for two-electrode arrangements and Figure 21 for three-electrode arrangements. These charts are called Equivalent Charts. Each curve refers to a particular value of the equivalent number and these values are given by Table 2.

To facilitate the use of the equivalent

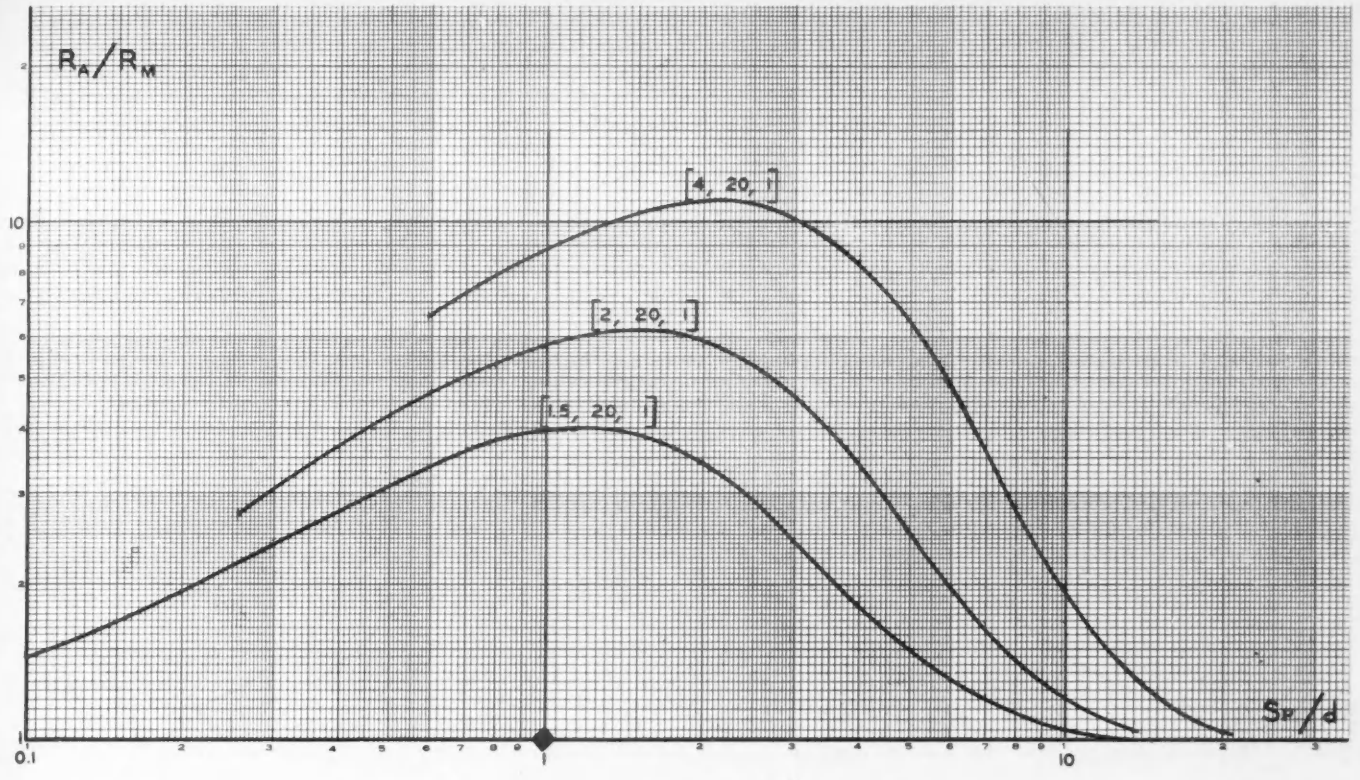


FIGURE 16. Resistivity departure chart for two-electrode arrangement showing effect of increasing degree of mud invasion (After Dakhnov, 1941).

charts, especially when interpolation is needed, the foregoing values of U are graphically represented on Figure 22 as a function of the quantities R_i/R_m and D/d.

In his 1938 book, Alpin discusses only the case of formations whose resistivity equals the mud resistivity. It seems to the writer that the equivalent principle can be generalized to include a larger resistivity range.

From experimental data and from certain analogies derived from the resistivity method of surface exploration, the equivalence principle is tentatively generalized as follows:

A departure curve established for a thick formation invaded by mud can be used for another formation provided the following conditions are fulfilled:

1. The numerical value of the resistivity contrast R/R_m must be the same for the two media.

2. The resistivity R_i of the mud invaded zone must be greater than the mud resistivity R_m and also greater than the formation resistivity R.

3. The value of the quantity

$$U_1 = (R_i/R_m - R/R_m) \ln D/d$$

must be the same for the media concerned.

4. The ratios D/d must be comprised between 1.2 and 4.

To what extent the foregoing generalization is correct is unknown to the writer, and it is therefore suggested that its application be made with care until more data on the matter are available. Nevertheless, it is probably correct for moderate values of the ratio R/R_m.

The equivalence principle can be further generalized to include formations for which R_i is less than R_m and R. In this case the corresponding equivalent number may have a form which is perhaps given by the following expression

$$U_2 = \frac{R_i/R_m - R/R_m}{\ln D/d}$$

It should be noted that the resistivity distribution corresponding to this number is only rarely found in practice because R_i is usually greater than R_m, as was pointed out in the preceding article. An exception should be made, however, for the case of formations which are invaded by a very salty mud and logged after the original drilling fluid is replaced by fresh mud. These instances are rare and a discussion of this condition is not warranted at present. Data on this condition are completely lacking in the Russian works.

Finally, before concluding this discussion it is worth mentioning that it is doubtful that some sort of simple equivalence principle applies to formations for which

$$R_m < R_i < R$$

or

$$R_m > R_i > R$$

TABLE 2

Numerical Value of Equivalent Number for Charts of Figures 20 and 21

CURVE	I	II	III	IV	V	VI	VII	VIII	IX	X
Equivalent Number	1.62	2.77	3.65	6.34	7.70	13.17	15.81	27.03	40.14	68.62

The Three-Medium Problem

In a discussion of thick formations invaded by mud we have to consider the three following media:

the drilling mud: resistivity R_m, diameter d; the invaded zone: resistivity R_i, diameter D; the non-invaded zone: resistivity R, diameter ∞.

If we are interested in determining only the true formation resistivity it is evident from an examination of a departure chart that this is theoretically possible by making a single resistivity measurement, provided the electrode spacing used is extremely long. However, as has been pointed out before this is frequently impossible (see Part 1), WORLD OIL, December, 1947), first because beds have a finite thickness (and therefore the charts discussed previously may not always be used), and second because the conventional logging instruments are not sensitive enough to give accurate measurements with very long electrode spacings. Incidentally, it is worth noting that the minimum spacing necessary to give the true resistivity of an invaded formation is several times greater than the spacing necessary for a non-invaded formation, all other factors being the same.

Even if a single measurement could be

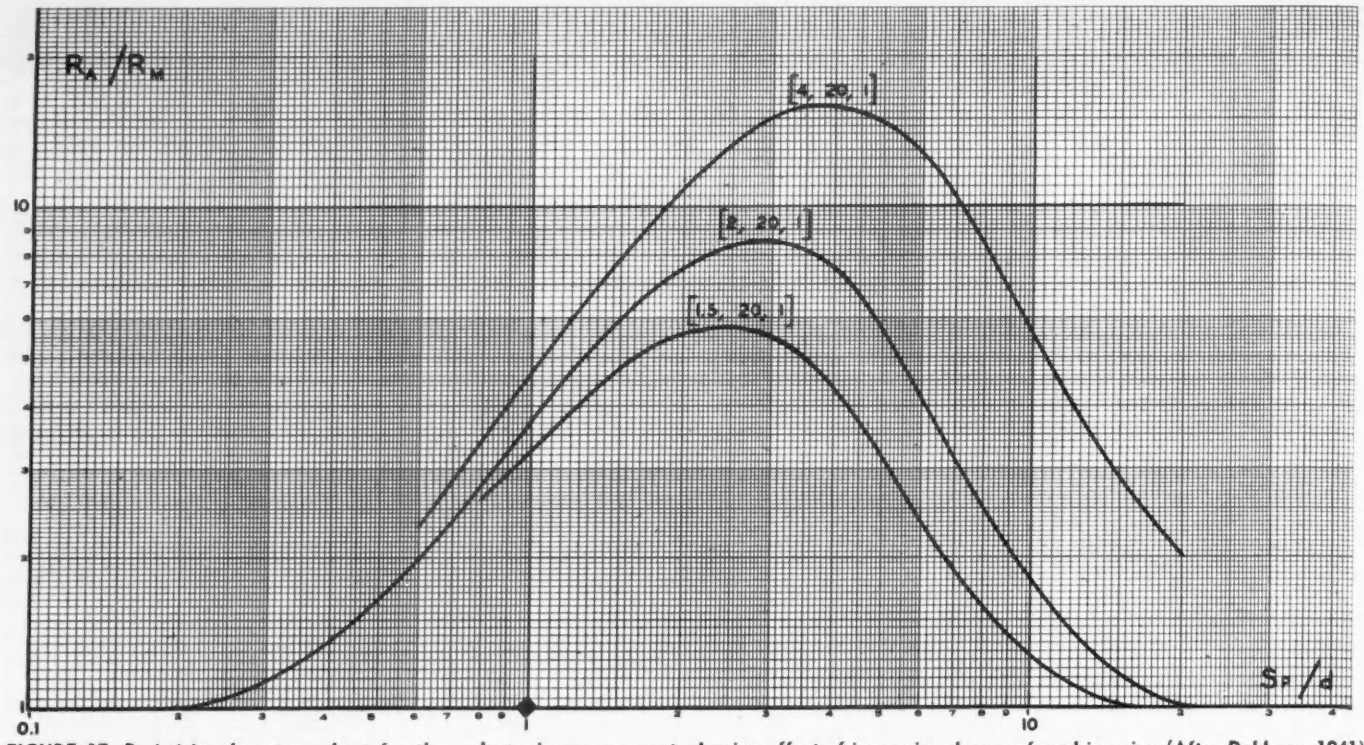


FIGURE 17. Resistivity departure chart for three-electrode arrangement showing effect of increasing degree of mud invasion (After Dakhnov, 1941).

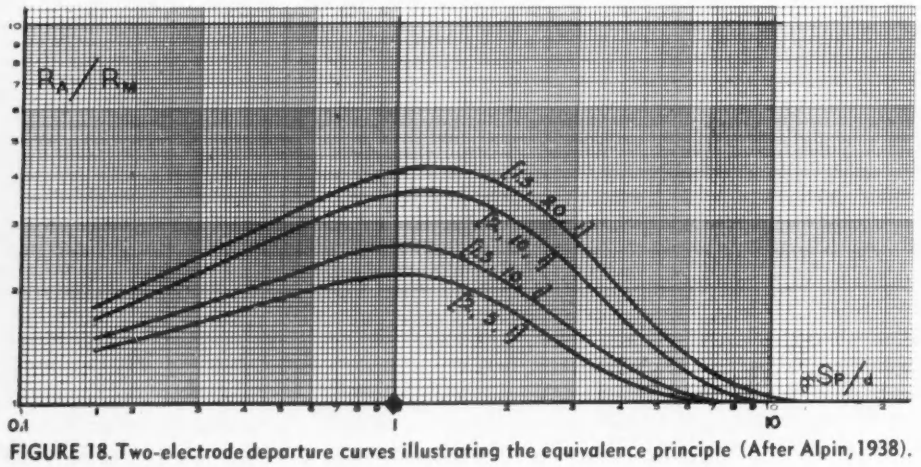


FIGURE 18. Two-electrode departure curves illustrating the equivalence principle (After Alpin, 1938).

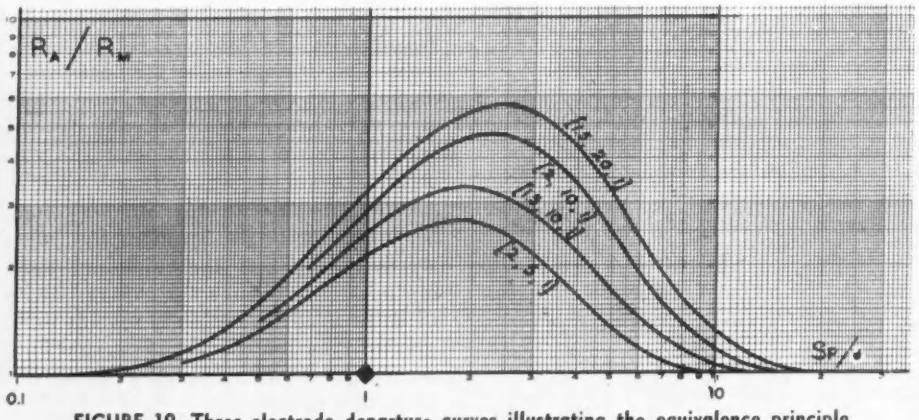


FIGURE 19. Three-electrode departure curves illustrating the equivalence principle (After Alpin, 1938).

made to determine the resistivity of a bed, it usually is advisable to make additional measurements with shorter electrode spacings in order to attempt estimating some other formation characteristics.

Before explaining how this can be done, it will be assumed that, in a petroleum reservoir, the mud which filters into the formation displaces simultaneously all the original fluids, namely petroleum and interstitial water. Although this assumption is perhaps not legitimate in many cases, it nevertheless will permit explaining simply some possibilities of electric logs, which is one of the main purposes of this series.

Formation Factor

The formation factor F of a reservoir can be expressed as a function of the effective porosity fraction P and of the cementation factor m, as follows:

$$F = 1/P^m$$

The numerical value of the cementation factor increases when the degree of cementation increases, all other factors remaining the same. Therefore, the number m measures to a certain extent the reciprocal of the permeability of the reservoir, but this measurement is evidently very crude and gives at best only qualitative data. The main obstacle is that m does not take into account the influence of grain size on permeability. Hence, the possibility of determining the permeability of a reservoir from the factor m alone is slim. But this determination may be possible, at least qualitatively, if the

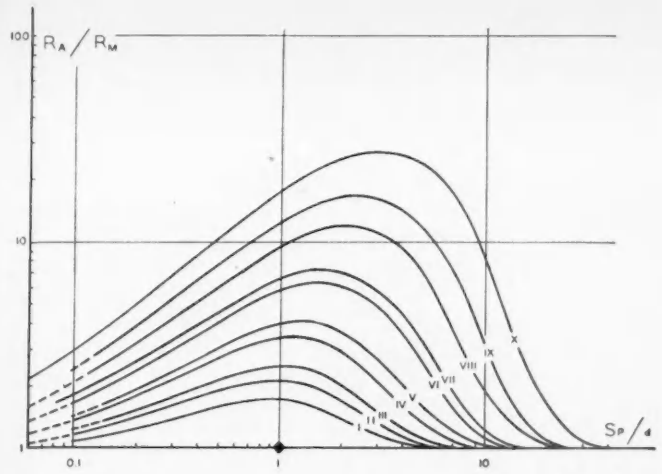


FIGURE 20. Two-electrode equivalent chart when resistivity contrast R/R_m is equal to unity (After Alpin, 1938).

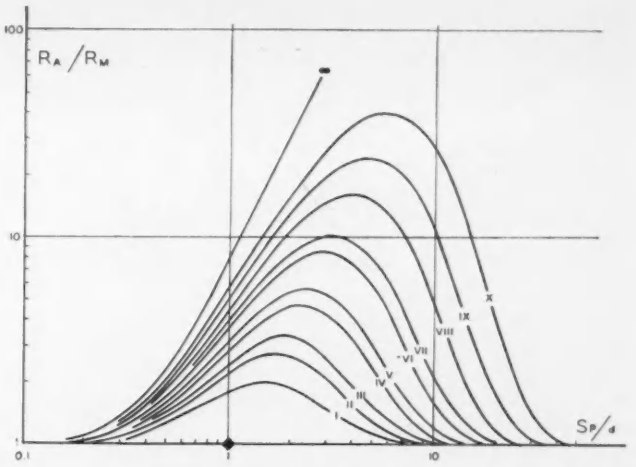


FIGURE 21. Three-electrode equivalent chart when resistivity contrast R/R_m is equal to unity (After Alpin, 1938).

grain size is approximately known. This, however, is not a very practical method and it will not be further discussed.

On the other hand, porosity determinations can be made in certain cases. For instance, if it is known that the reservoir is not cemented, then m is equal to 1.3 and the formation factor is equal to $1/P^{1.3}$.

In the preceding article it has been shown that the formation factor can be expressed as a function of R_t and R_m as follows:

$$F = R_t/R_m \qquad (1)$$

Hence:

$$P = (R_m/R_t)^{\frac{1}{1.3}} \qquad (2)$$

Inasmuch as the factor R_t/R_m can sometimes be determined from resistivity measurements (as will be shown later), then it is possible to determine the porosity of certain reservoirs from an adequate electric log.

If the reservoir is cemented, but only moderately, it is sometimes possible to estimate the value of m, either from experience or perhaps also from a mechanical log. In this case the reservoir porosity is approximately given by the following relation:

$$P = (R_m/R_t)^{\frac{1}{m}}$$

The error made by using this relation is small when the degree of cementation is small.

Figure 23 represents graphically the porosity of a reservoir as a function of R_t/R_m.

Petroleum Saturation

The petroleum saturation of a granular reservoir can be frequently estimated from the following relation:

$$S = 1 - \sqrt{\frac{F R_w}{R}}$$

It will be shown later that R and F can sometimes be determined from an

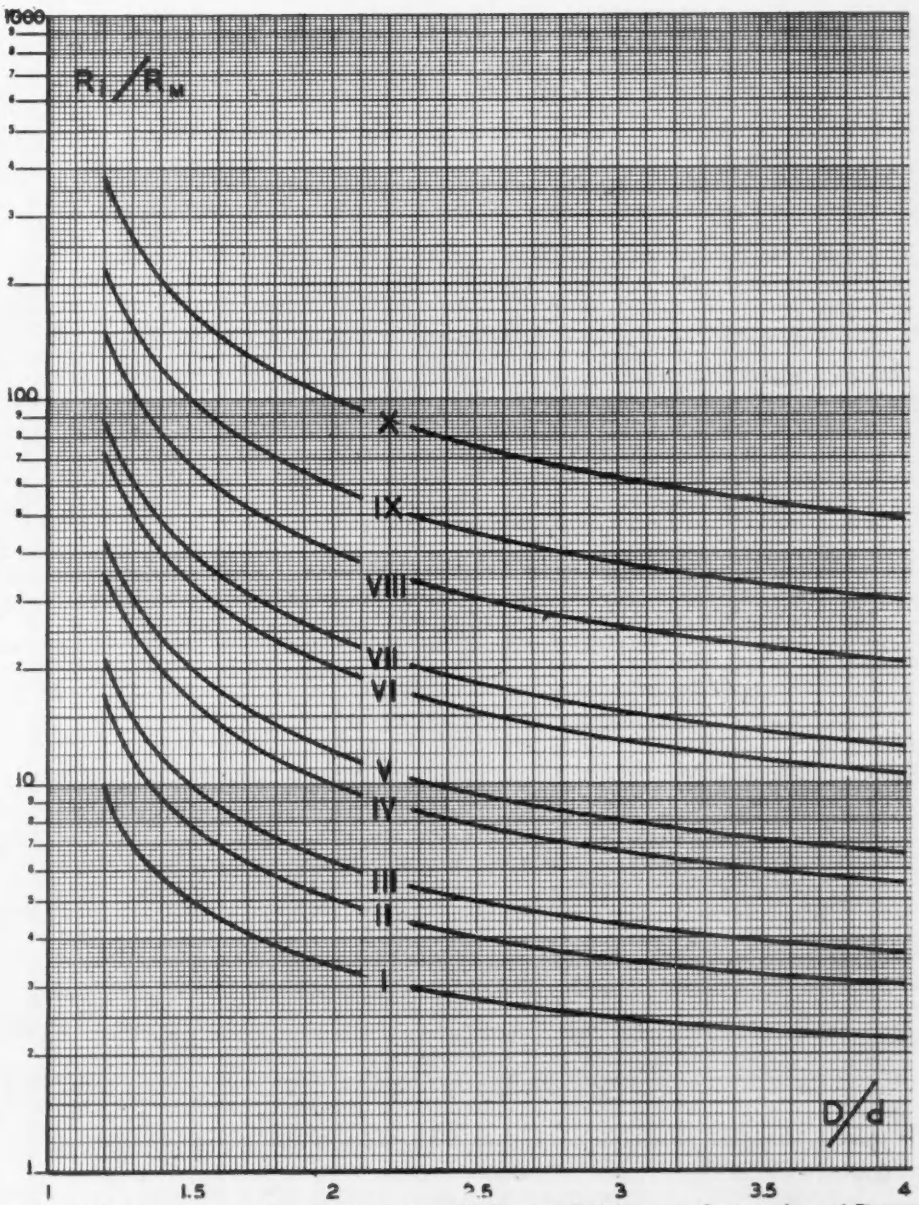


FIGURE 22. Chart representing relation between R_t/R_m and D/d for equivalent numbers of Figures 20 and 21 (After Alpin, 1938).

adequate electric log. Therefore, if the interstitial water resistivity is known (for example, from a water sample, or if a known salinity trend exists) the petroleum saturation of certain reservoirs can be estimated with fair accuracy.

Extent of Mud Invasion

The greater the permeability of a reservoir, the greater the degree of mud invasion, all other factors remaining the same. With certain types of mud and certain types of reservoirs it is therefore probably possible to obtain qualitative permeability data when the extent of mud invasion is known.

From some of the preceding discussions it has been shown that the apparent resistivity is dependent upon the diameter of the mud invaded zone and that the exact effect of this factor is known. The process can sometimes be reversed, namely the degree of invasion can be determined from an adequate electric log, whereby relative permeability data can be obtained.

Importance of Mud Invasion

Until recently the effect of mud invasion on an electric log was considered a nuisance. The preceding discussion shows that a moderate amount of invasion, for example of the order of twice the hole diameter (i.e., $D/d = 5$), is on the contrary a condition to welcome in electrical logging because it may give some reservoirs characteristics: porosity and permeability. In addition it frequently helps securing more accurate data on the petroleum saturation.

It will be shown later that a moderate invasion does not interfere with the determination of formation resistivity, provided adequate resistivity measurements are available.

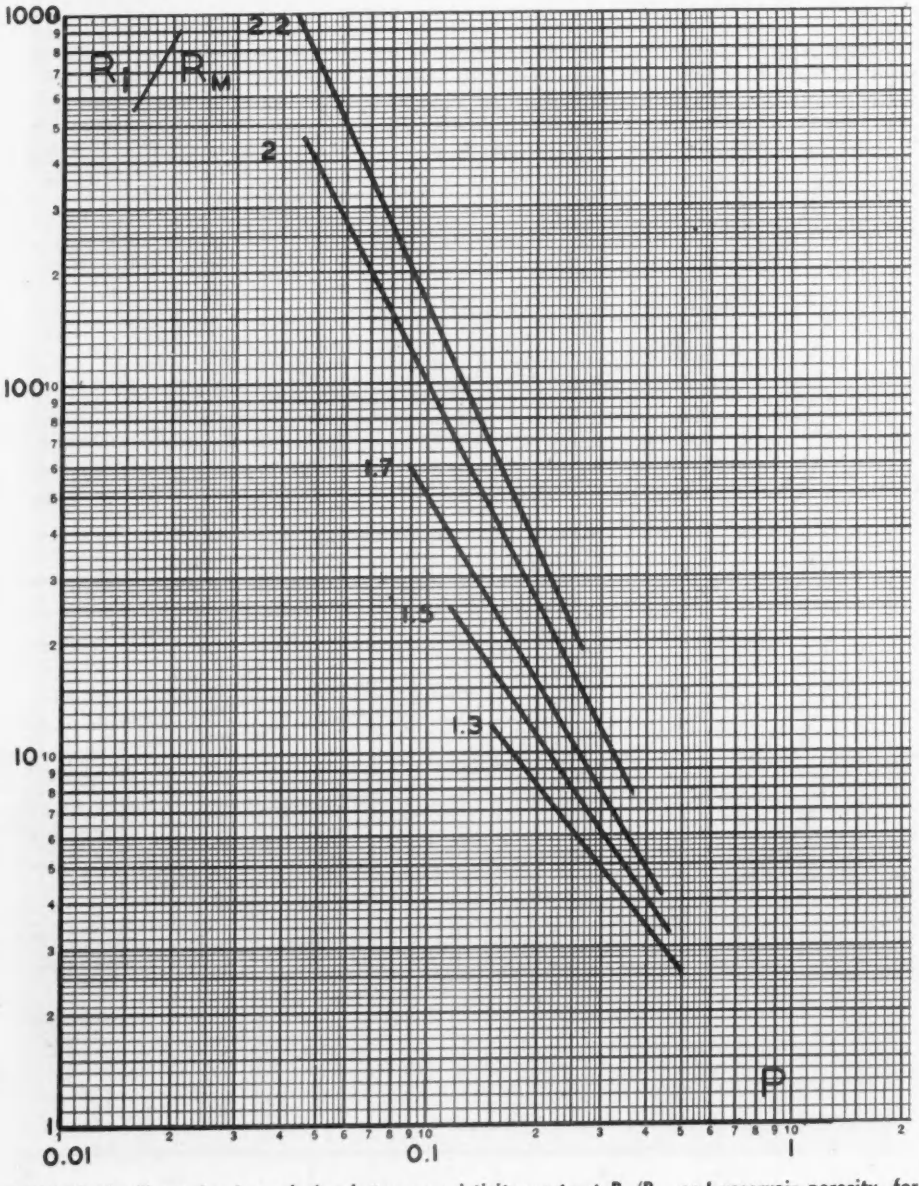


FIGURE 23. Chart showing relation between resistivity contrast R_i/R_m and reservoir porosity, for different values of cementation factor.

Hole Diameter

It is well known that in most petroleum reservoirs the hole size is close to bit size, but that in some of them appreciable caving has been observed. These exceptions always occur in soft sands. Caving is therefore an indication that the reservoir concerned is very little, if at all, cemented. This information may be useful when the driller's log is poor and when little is known on the reservoir, such as in exploratory wells. In addition to yielding data on one of the reservoir characteristics, this information is generally of value also for the porosity determination mentioned above.

It is obvious from the foregoing discussions that the hole diameter, and hence the caving, in a mud-invaded formation can be determined from an adequate electric log.

Possibilities of Resistivity Data

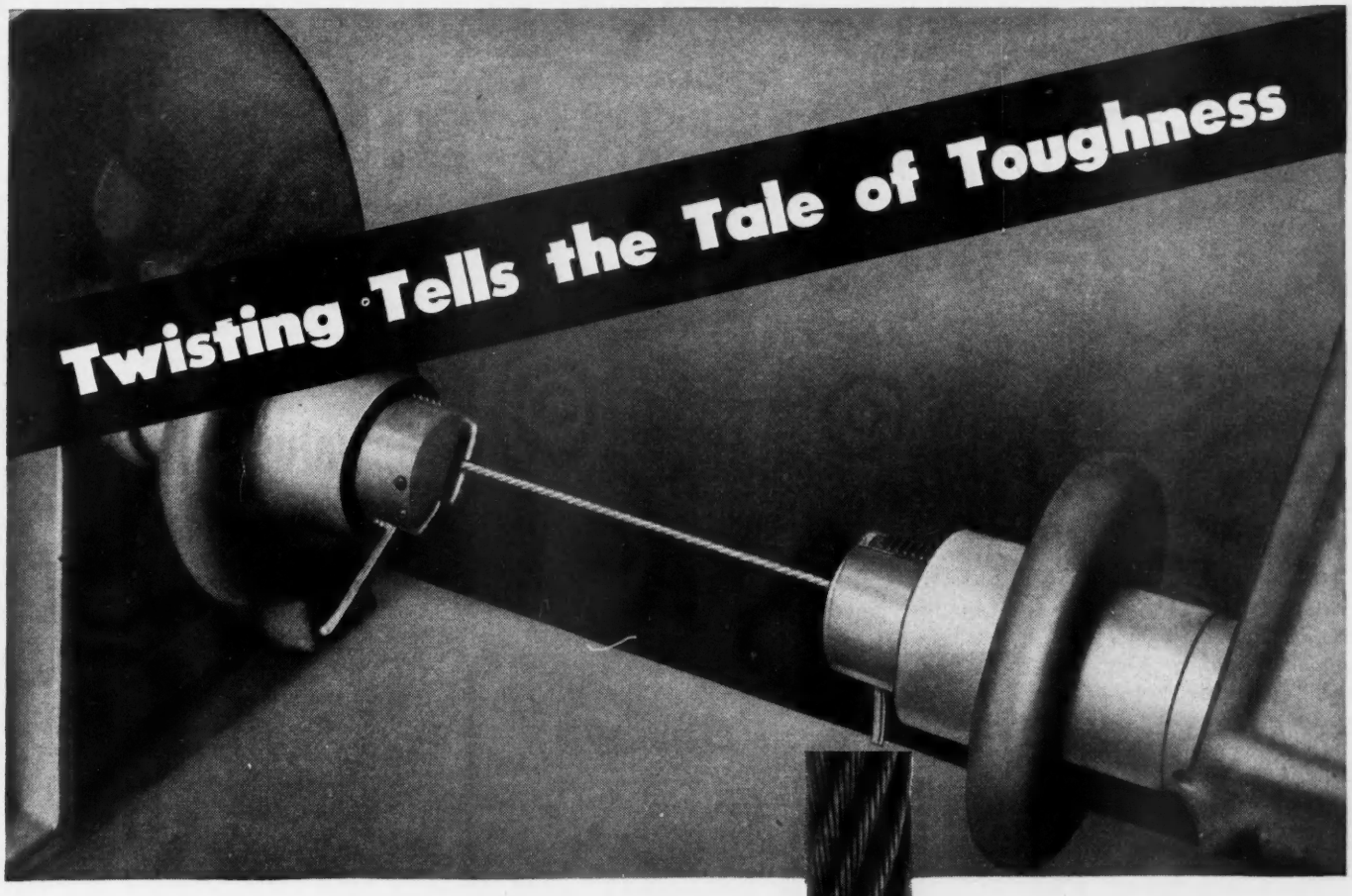
In the past an electric log was interpreted exclusively with a view of determining the true resistivity of possible reservoirs penetrated by the bore, with the ultimate purpose of securing qualitative or quantitative data on petroleum saturation.

The preceding sections show that other important formation characteristics also can be estimated from the log. In many cases these estimations will be very crude; nevertheless, they frequently will be of great value to the Petroleum Engineer when he has no other data to rely upon, such as in exploratory wells.

One important requirement for securing this information is that the electric log must give enough equations between the involved unknowns, i.e. must comprise a minimum number of resistivity graphs. Only a few of the logs run in the past fulfill this condition, and therefore many of them cannot be used for this purpose. But this can evidently be remedied in the future.

Another requirement is that adequate interpretation data be available. Too few are at hand at present to permit a wide use of the possibilities outlined above. The Russian authors have done an excellent analysis of the problem, but at the time their work went to press (1938 and 1940) they had not had time to translate their findings into really practical interpretative techniques. It is hoped, however, that the new treatments on electrical logging being printed at present in the USSR will bring at least part of the lacking information.

The temporary lack of data should not deter us from running today comprehensive electric logs, even if their interpretation cannot always be fully made at the present time. The field data which will be assembled now can be used profitably later when satisfactory interpretative methods are available.



Here we see an 8" piece of rope wire being twisted on its own axis. The revolutions necessary to break the wire are counted and only those coils are accepted which test at least 10% above American Petroleum Institute specifications for wire rope. In addition to being an indication for toughness, the torsion test reveals whether the wire is free from steel defects such as seams and cups.

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DRILLING HINTS

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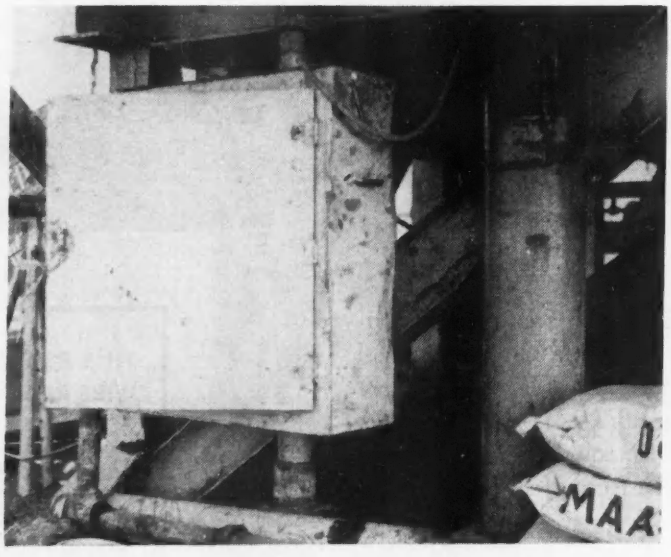
How To—Equip Substructure with Mud Testing Apparatus

The modern drilling rig substructure undergoes probably more modifications than any other individual piece of equipment on the rig. For reasons of conserving space, reducing amount of handling, installation and disassembling work, many added devices to the rig have been incorporated into the substructure as a permanent unit. When the substructure is moved, it forms a protective framework for those devices which it contains.



To its many added pieces of auxiliary equipment comes another . . . the drilling mud testing apparatus. The projecting ends of each horizontal I-beam affords protection for this attached equipment. It can be moved with safety by attaching the cabinet to a supporting post welded to the lower horizontal beam of the substructure. Each piece of testing gear is secured inside the heavy steel plate cabinet to prevent it from breaking when the substructure is loaded or unloaded from trucks.

A pedestal is set inside the lower beam so the cabinet is protected by the overhand of the floor. The large pressure tank is also set permanently beside the cabinet by welding a retainer ring to the substructure and bracketing the drum to one of the sway braces to keep it vertical. By centralizing the mud testing equipment, loss of these items is found to be reduced, and breakage is also minimized. The gear is protected from the weather and is in a convenient position for making the various tests on drilling muds. With a large pressure vessel, the time between exchanges with a new bottle of nitrogen is considerably lengthened.

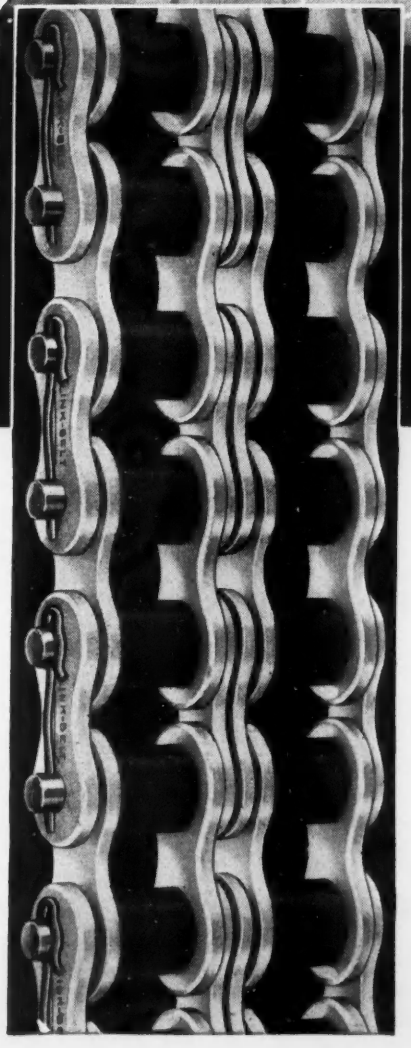
How To—Install Dual Blower Control for Efficiency and Simplicity

Use of exhaust steam to give forced draft to the rig boilers when waste steam is returned to the boiler setting for feedwater heating may be simplified. The feedwater heater is mounted on a skid which also provides boiler smoke-box support. This setup required a minimum of pipe between heater and blower inlet and brought the control valve within easy reach from outside the skid.

To provide live steam for blower operation when none of the rig equipment is operating, a live steam header flanks the heater shell, with branch lines and valves entering the blower inlet pipe above the feedwater heater control valve.

The live steam control valve is mounted close under the boiler shell, but in a position where it, like the other, may be readily reached from outside the skid to provide regulation without danger of a burned hand.

A split union is used to tie the combined steam connection to the blower inlet line. This is the only joint which must be broken when the skid is to be pulled from beneath the boiler battery for shift to a new location. Alignment of the supporting cradle on the skid side member also provides for proper setting of the blower connection. Thus no pipe fitting is required after the unit is once assembled.



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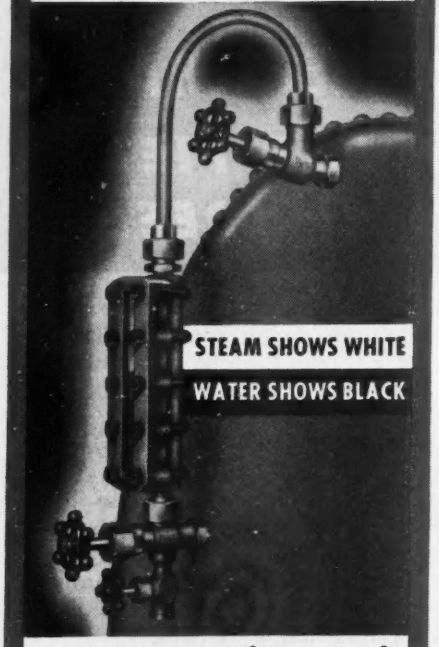

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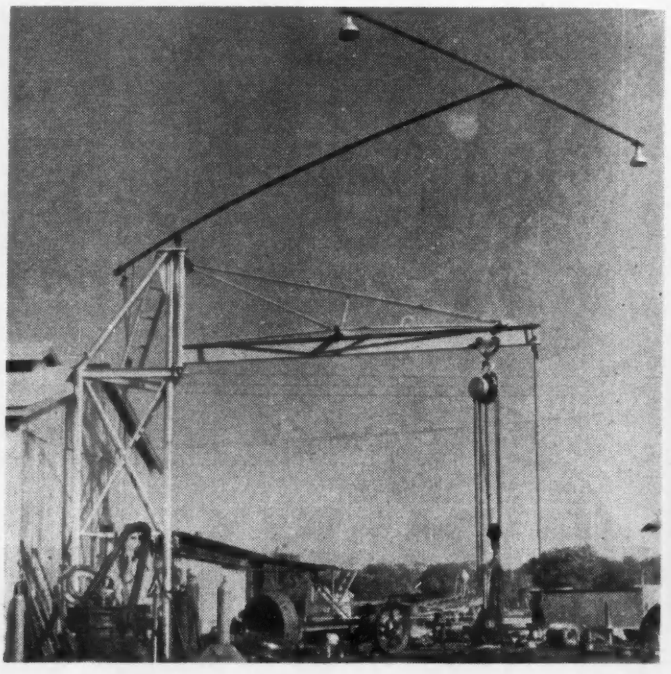
How To—Support Flood Lights Over Working Area



Flood lighting the working areas of the material yard for night loading or unloading can be accomplished in a simple and efficient manner without the need of setting heavy light poles that may form an obstruction. Such a method of lighting is illustrated, where the flood light arms are pivoted on top of the structure which supports the horizontal lifting boom. A joint of extra heavy 2½-inch pipe is fitted with a clevis near one end which is connected to a pin in the top of the boom supporting structure. The opposite end of this balance member carries at 90-degree angles two short sections of pipe to which is mounted the pair of flood lights facing downward. Near the short end of the balance member a loop is placed for connecting a light block and tackle with which to make adjustments for height of the flood lights. This leverage system also permits the lights to be lowered for replacement and cleaning.

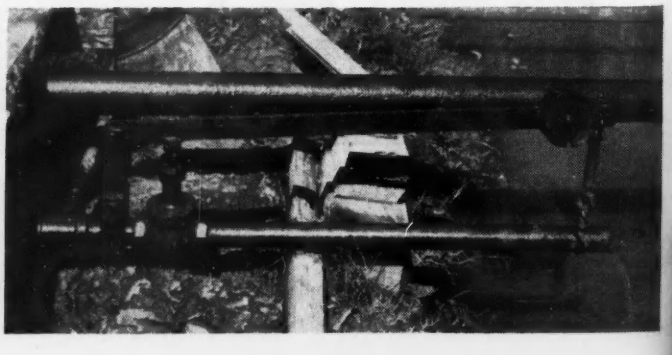
This simple construction provides an obstruction-free area in which to load and unload heavy drilling equipment, and at the same time produce ample lighting where it is needed most. With two lights, shadows are minimized and better working conditions result.

How To—Check Relief Valve Pounding

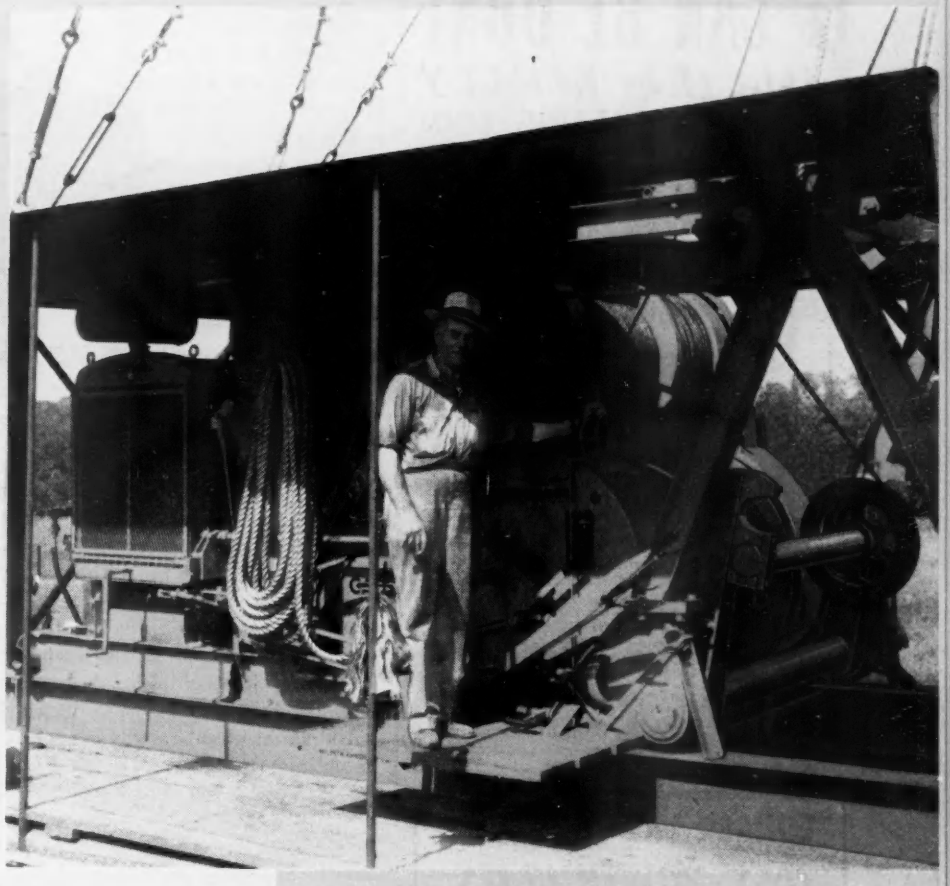
A standard globe valve from which the bonnet threads had been removed was converted to a relief valve for the fresh water system of one rig. The desired head was maintained by a simple lever, with fulcrum at one end, and the two arms proportioned to require a small weight at the outer end to balance the pump pressure.

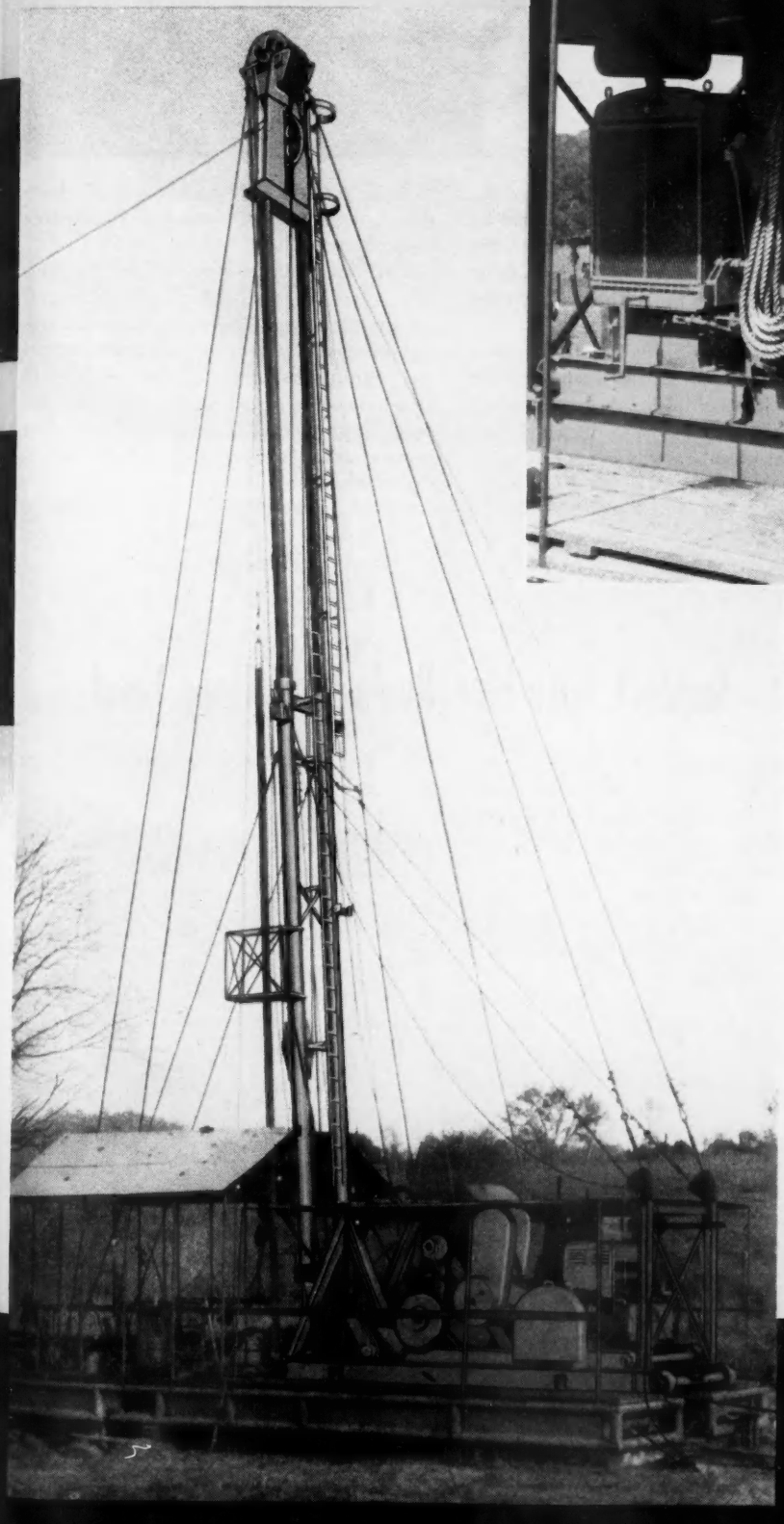
The tendency of the valve to chatter on its seat as the pressure approached the set maximum was checked by using a coiled spring between lever and overflow pipe, so that the spring could check the throw of the weighted arm under pump impulses.

The combination of spring and weight allowed the excess water to escape uniformly, thus avoiding cutting of the valve and seat.



CABLE TOOL RIG BREAKS RECORDS





Faster strokes and higher line speeds quicker moves result in the lowest cost per foot in the area. That's how this "Cardwell" Model R three-drum rig is now breaking drilling records in the Appalachian area.

This standard Model R double drum rig with the addition of a third drum and other assemblies, has proved a most efficient rig for top-to-bottom cable tool drilling. Rig is completely unitized for fast, low cost moves. Shock absorbing crown and fly-wheel stabilizer make faster drilling possible.

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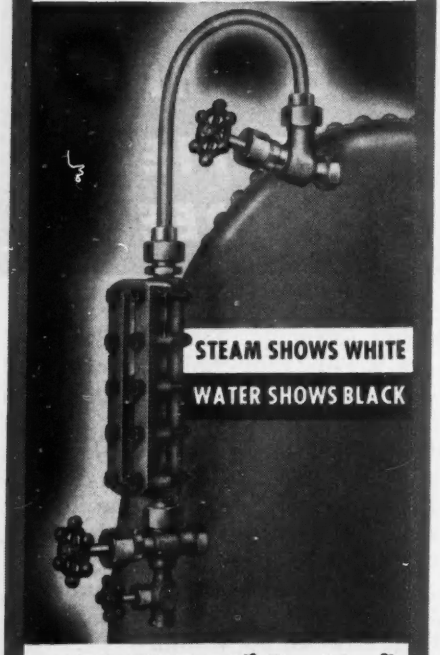

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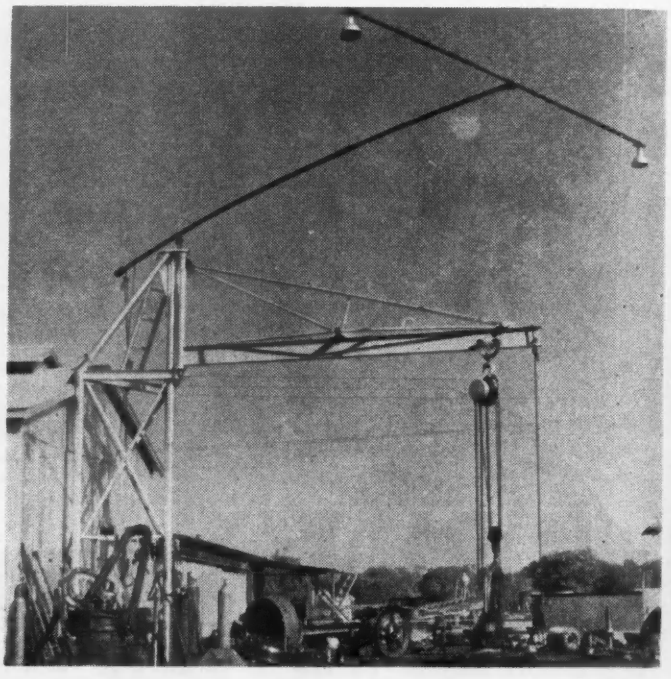

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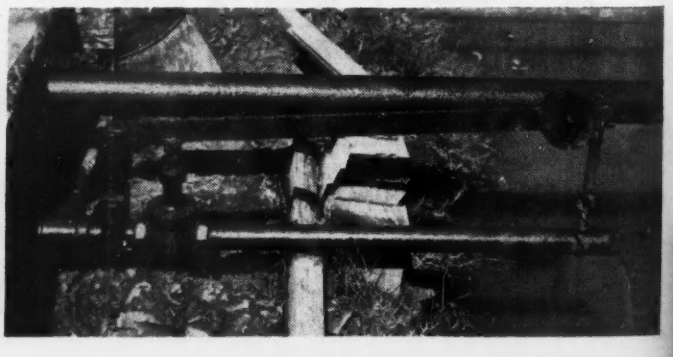
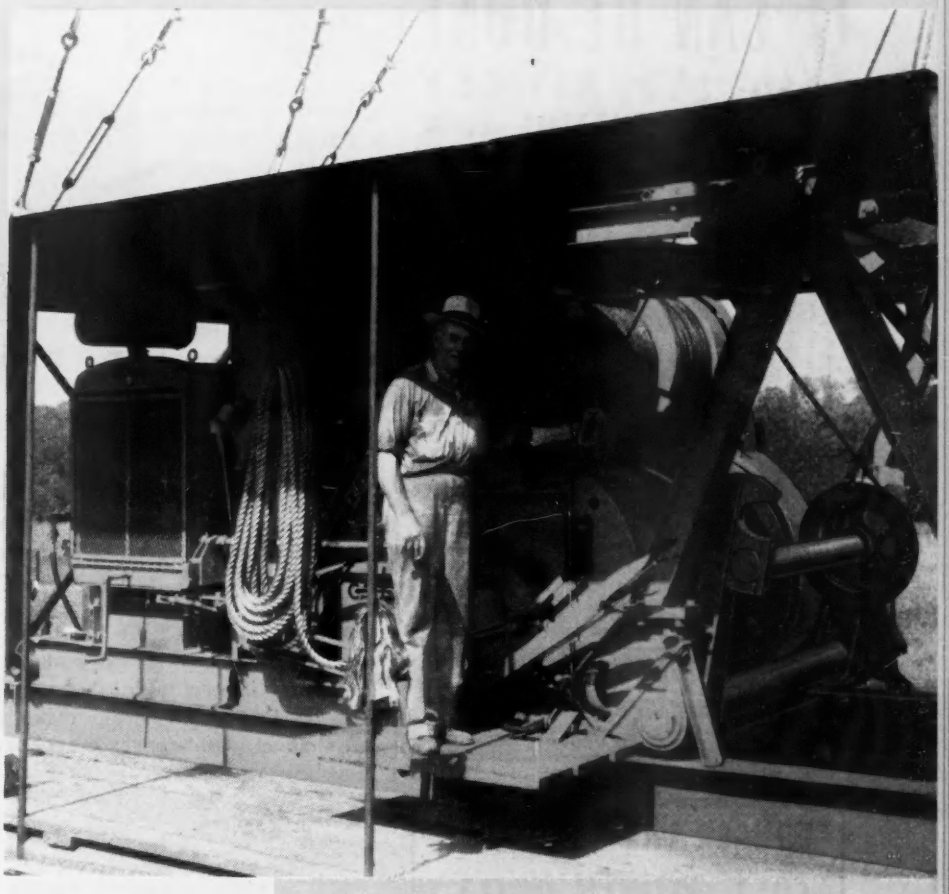
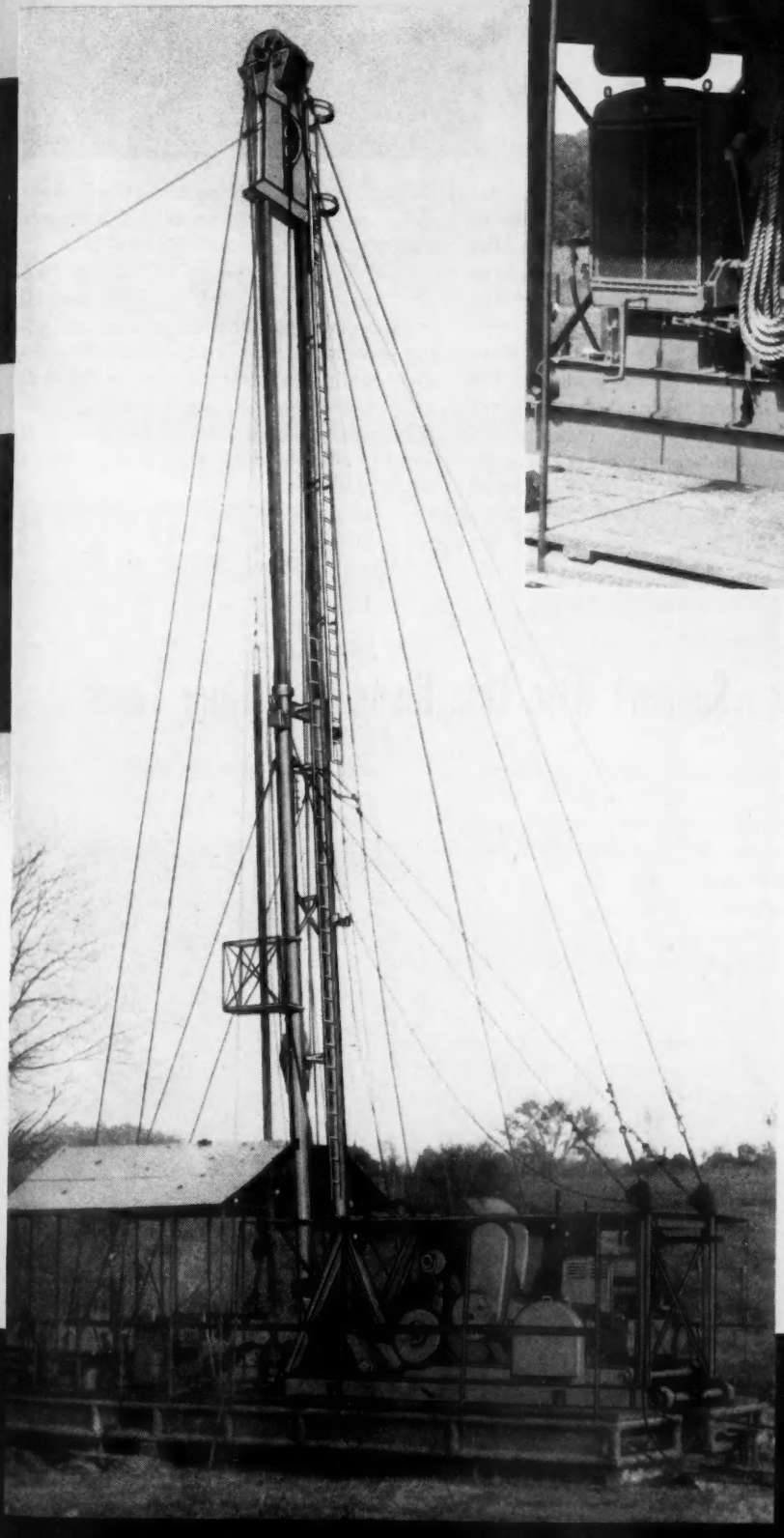


CABLE TOOL RIG BREAKS RECORDS





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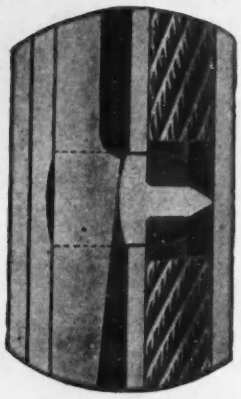

Enlarged drawing of section of tool inside tubing, showing tapered wedge forcing knife thru wire line.

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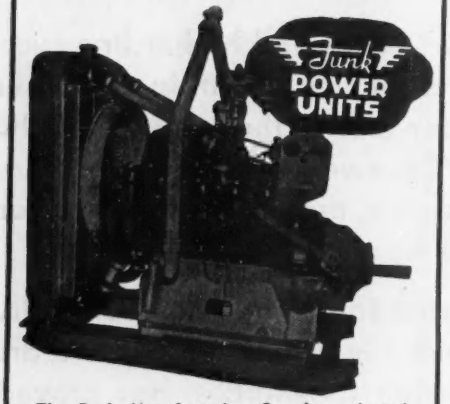

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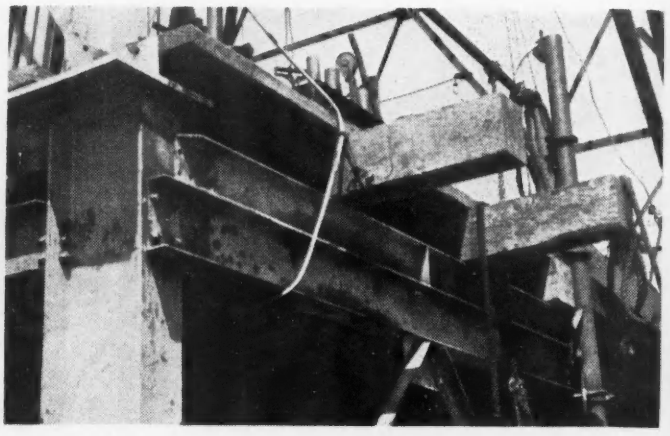
How To—Elevate Derrick Floor Flush with Rotary



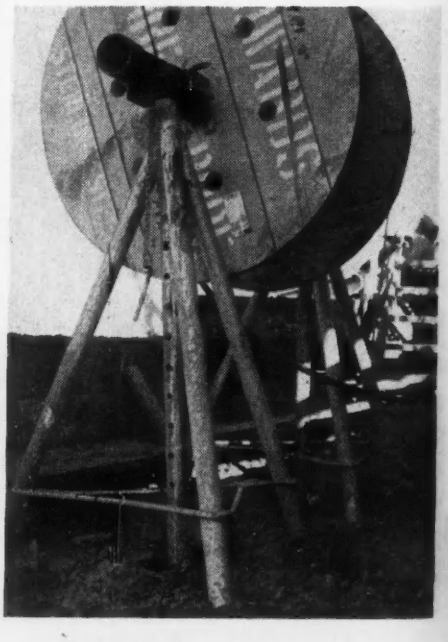
Design of the derrick floor may vary from rig to rig, some operators preferring a step or break in the floor at the rotary while others permitting the rotary to project above the floor level. One of the most popular methods of derrick floor construction is that shown, where the floor surface is flush with the top of the rotary table. Although this type installation requires additional work in rigging up substructure members, the advantages of having the entire floor level with the table more than offsets the slight extra cost.

As illustrated, an extra length of channel iron having a width equal to the projection of the table above ordinary floor level, is bolted on top of the principal channel member which supports the floor joist members. Heavy 12x12-inch timbers rest directly on the added channel iron at approximately 90 degree angles.

The floor may be nailed to the timber joists to provide a firm anchor for the planking. The advantages including increased safety and improved working conditions around the table will offset possible slight operating disadvantages encountered due to the fact that ramps and ladders may stand at a slightly steeper angle.

How To—Support Wire Line Reels Near Floor Level

Height of the wire line reel support can be varied to suit conditions when rigging up, or tearing down. One contractor builds the support with two identical tripods in which the top ends of the legs are welded to a heavy three-inch nipple. A vertical piece of two-inch extra-heavy pipe is fitted with a cap, made of wide channel iron, and drilled with regularly spaced holes so it can be raised and lowered and locked in the desired position with a pin passed through the hole selected to obtain the height. A similar hole is drilled in the three-inch nipple just above the point where the three legs are welded. Slipping a convenient piece of pipe approximately the size of the hole in the ends of the reel provides means for resting the reel upon both tripods in the channel iron caps. Wedges can be used to steady the reel axle while the line is being removed, or reeled up again before shipping. The lower ends of the tripod legs are fitted with wide square plates of steel so the load may be more evenly supported on soft ground.



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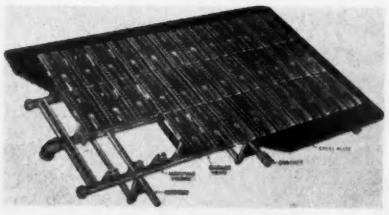

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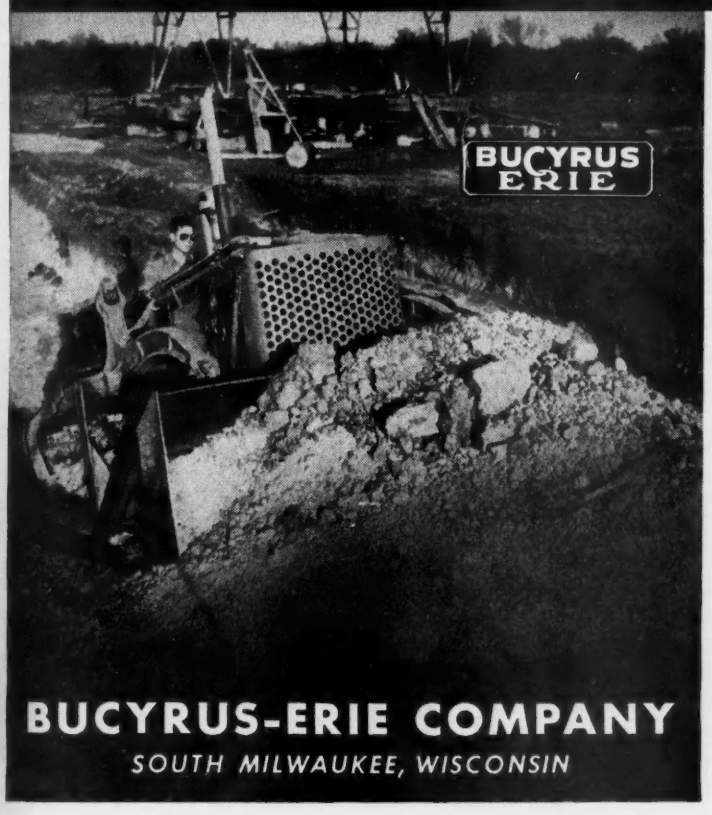

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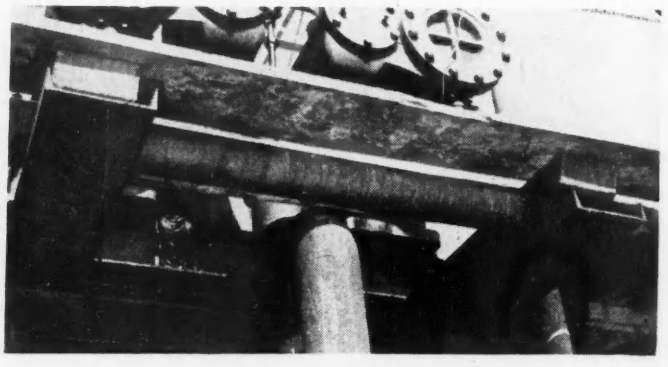
How To—Incorporate Skid Guides in Substructure

Skid guides may be made from two parallel ten-inch channels on the upper side of the drawworks mounting and then bolted rigidly to the steel supporting members so that they become a part of the unit.

These two channels served as guides to simplify sliding the engine skid into place, the eight-inch built up members fitting snugly inside the webs of the channels.

With the channels serving as the mounting guides for the skid, one winch truck was able to place a 14 x 14 drilling engine without excessive tackle.

The usual Vee-block alignment guides are used to insure proper run of the chain on the sprockets, and the engine is fastened to the base of the foundation with the usual eye-bolts and turnbuckles, the clearance in the channels allowing the engine to shift to meet the alignment guides without binding.



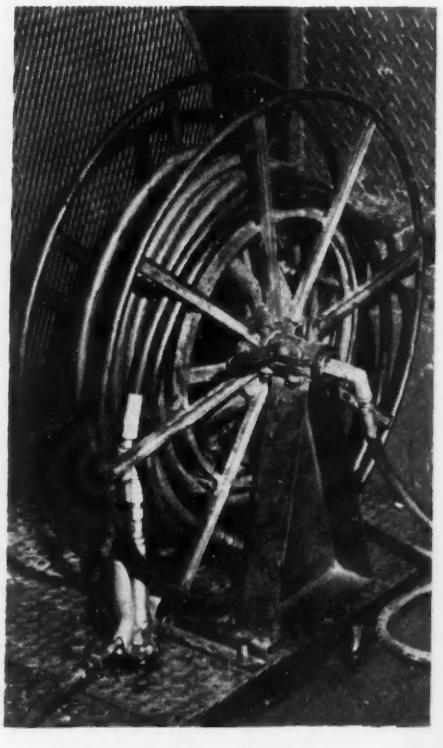
How To—Care for Lubricating Hose

The use of air-pressurized lubricating units have facilitated the job of greasing the drilling rig. In order that all points about the rig floor requiring regular lubricating be reached, a long hose is usually provided with a lubricating nozzle at the end. If not properly cared for when not in use, this grease-gun hose not only forms a stumbling hazard for crewmen working on the floor, but it is also subjected to undue wear and tear when kicked around, etc.

A very handy reel on which to wind this hose when not in use has overcome the possible disadvantages mentioned above. The reel consists of two solid ½-inch steel bars welded in a 26-inch diameter circle, and supported on either side with eight spokes made of ¼ by ¾-inch channel iron. Hub of the reel is of a section of ¼-inch by six-inch diameter plate steel to which the lower end of the spokes on either side are welded. The drum for the hose is formed by welding a piece of ¼ by ¾-inch flat steel in a circular shape and attached to the spokes. Cross pieces forming the drum or hub join the two wheels together in a rigid unit and give support for the hose.

A piece of strap iron ¼ by 4½ inches forms the housing for a bronze bushing. This housing is welded to a triangular frame and the completed unit is bolted to the derrick floor. A U-bolt through the strap iron housing contains a brake handle which when pushed in a vertical position clamps the housing down on the bushing and thus locks the reel at any desired point. The inside spokes of the far wheel are welded at the center of the rim, then bent down and fastened to the hub. This provides a hollow or unobstructed inside area through which the hose is connected.

Grease is furnished to the hose contained on the reel through a packed off swivel which permits the reel to rotate without interferring with greasing operations.



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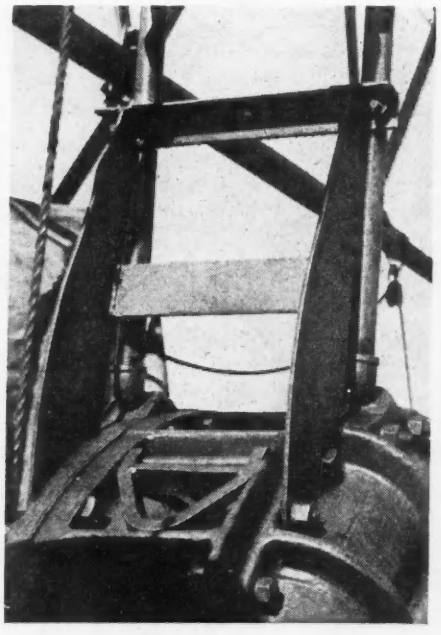
How To—Support Hydraulic Brake Connections

To protect the threads in the housing of the hydromatic brake from possible damage through vibration of the pipes used to handle the flow of water to the unit, one contractor uses a neat and very effective support. The device is made up from two bracket sides, each fitted to the brake housing and retained in place by pairs of bolts used to assemble the housing. An angle iron at the top and lateral brace halfway up the unit provides the necessary stiffness to support the pipes without strain reaching the castings.

Each pipe is clamped to the bracket or support by means of a U-bolt passed around the pipe and through matching holes in the angle iron at the top of the device. The support is located on the brake housing so that the fixture provided for lifting the brake can swing clear of the brackets and the lifting line can be used between the side members.

Unions on both pipe lines permit them to be broken for shifting or replacing the hose sections without moving the portion held by the clamps on the support.

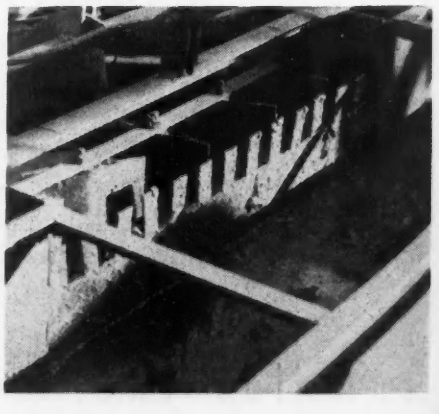


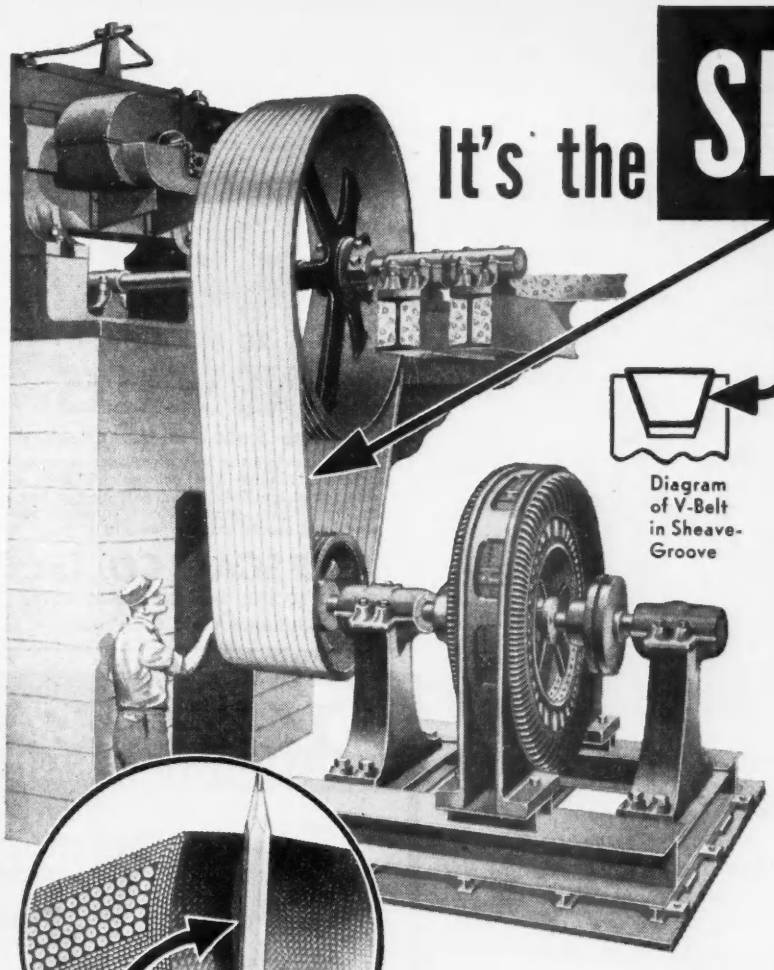
How To—Distribute Mud Evenly Over Shaker Screen

The most efficient operation of the shale shakers is obtained when the returning fluids are made to distribute themselves evenly over the entire area of the shaker screens. Greater volumes of fluid may be handled in this manner with a minimum loss of useable mud into the shale pit.

A simple, yet ingenious device was installed in the mud system to provide an even flow of fluids over the vibrating screens. The use of elevated steel mud ditches facilitated the installation, but such a device could be used on any conventional shale shaker.

It consists simply of a section of steel floor plate (boiler plate or tank steel would suffice) that has been cut to fit the throat opening into the shaker. In the case illustrated, slots were provided on either side of the opening to accept the steel plate. It was cut to fit this opening with minimum leakage of mud, and 13 notched weirs were cut in the top edge. These notches are approximately two inches wide and three inches deep. When drilling operations are in progress and a full flow of mud is returned from the well, it fills the ditch up to the bottom lip of the weirs and the fluid is then permitted to pass onto the screen evenly, thereby providing maximum efficient separation of the solid particles brought up from the bottom of the well.





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Every ounce of load a V-Belt carries must first be picked up by the sides of the belt. Clearly so, because only the sides come into contact with the pulley! The sides do all the GRIPPING on the pulley. The sides pick up the load. They transmit that load to the belt as a whole. And then, once more, the sides—and the sides alone—grip the driven pulley and deliver the power to it. Finally, the sides get ALL THE WEAR against the sheave-groove wall.

That is why you have always noticed that the sidewall of the ordinary V-Belt is the part that wears out first.

That's Why the Concave Side

(A GATES PATENT)

IS IMPORTANT TO YOU!

Clearly, since the sidewall is the part that wears out first, anything that prolongs the life of the sidewall will lengthen the life of the belt—and that's why the patented Concave Side is important to you.

The simple diagrams on the right show exactly why the ordinary, straight-sided V-Belt gets excessive wear along the middle of the sides. They show also why the Patented Concave Side greatly reduces sidewall wear in Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belts can possibly give.

and the CONCAVE SIDE is more important NOW than ever before

Now that Gates SPECIALIZED Research has resulted in Super Vulco Ropes capable of carrying much heavier loads—fully 40% higher horsepower ratings—the sidewall of the belt is called upon to do even more work in transmitting these heavier loads to the pulley. Naturally, with heavier loading on the sidewall, the life-prolonging Concave Side is more important now than ever before!

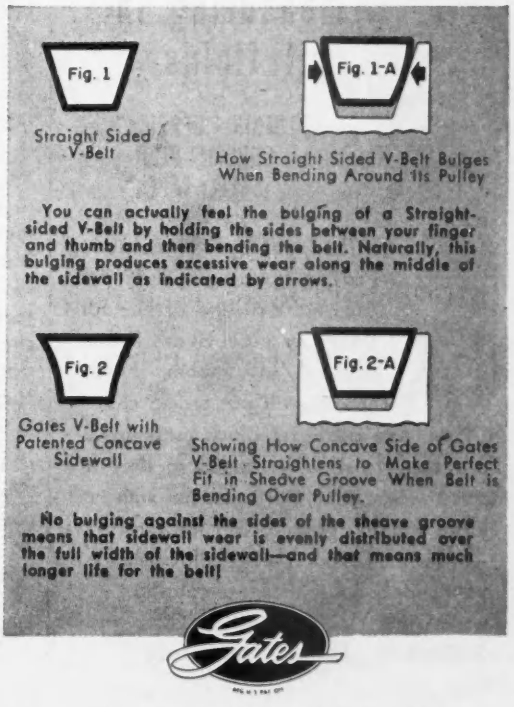
Fig. 1
Straight Sided V-Belt
Fig. 1-A
How Straight Sided V-Belt Bulges When Bending Around Its Pulley
You can actually feel the bulging of a Straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.
Fig. 2
Gates V-Belt with Patented Concave Sidewall
Fig. 2-A
Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt is Bending Over Pulley.
No bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!
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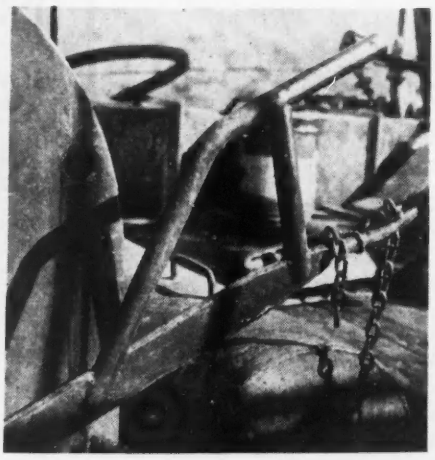
How To—

Extend Brake Handle



Two short pieces of one-inch pipe are used to make a handy extension to the brake handle or lever on the drawworks. The longer piece of pipe is notched to fit over the flat edge of the lever, and bent so that the outer end will lie parallel to the lever some eight inches above it. The short piece of pipe is used as a brace between the extension and original lever end.

Such an extension permits the driller to engage or release the hold-down chain without danger of pinching or jamming his hand if the lever jerks. It also, in the right-angled recess between original lever and brace, gives a safe foothold if the driller wishes to hold the brake with his foot.

The extension also makes the brake lever come at a convenient operating height over a longer period of brake block wear than did the original equipment. The slight additional weight of the lever through the pipe extension is not enough to overbalance the lever return linkage or to make the brake drag when hand or counterbalance pressure is released.

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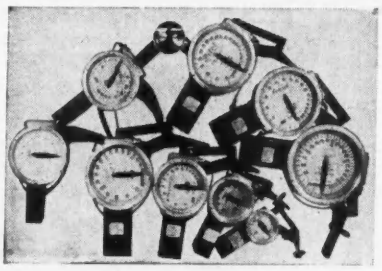

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Development and Exploratory Trends in the Rocky Mountain Region

By C. M. BOOS
and
L. BRUNDALL
Geophoto Services, Denver

A very active campaign of exploration for new sources of oil is on in the Rocky Mountain region. Mid-Continent and Pacific Coast oil companies and individuals have entered the area for the first time and others have expanded their staffs and increased activities. This article outlines these developments.

EXPLORATION in the Rocky Mountain region is being carried on by almost every known method from reconnaissance surface studies to the more recently developed or refined techniques of airborne magnetometer surveys and photogeological evaluation. Current surveys have included a restudy of most of the known surface structures, stratigraphic investigations to indicate the possibilities of buried shore lines and wedges, extensive geophysical programs, chiefly gravimetric and seismic, and some slim-hole drilling to determine structure and stratigraphy.

Intensive oil exploration in the Rocky Mountain area began about 1914, and in the next ten years most of the visible surface structures along the foothills were mapped and tested. By 1930 even the most remote areas had been prospected to some degree, but the limitations of drilling equipment and transportation were such that in most cases only the shallow horizons were tested.

The recent intensified search for new oil reserves has turned to the Rocky Mountain region because of the large unexplored areas in the middle of the intermountain basins, whose subsurface structure is now open to interpretation through modern geophysical technique, and because of the possibilities of developing new production from deeper horizons in known productive structures.

Much of the new production in the Rocky Mountain area in the past three years has come from the deepening of shallow fields, or through progress in refining technique which has made it possible to use previously unwanted types of crude. In Montana the new Madison line pools at Cut Bank are in an old field; the Ellis sand development at Cat Creek is in a field 25 years old and within a few hundred feet of a dry hole drilled to the pre-Cambrian several years ago. In Wyoming the recently developed Tensleep production at Elk Basin comes from a field which had extensive production from Cretaceous sands over a period of 30 years. Black oil producers such as the Frannie and Oregon Basin fields had a slow and intermittent development for many years until recent wartime demand and better refining techniques brought their crude into demand. The discovery well in one small black oil field (Spence Dome in Wyoming) remained capped for 17 years and then pumped 500 barrels from 800 feet on the day it was reopened.

Rangely anticline in northwestern Colorado was first mapped in 1878 and first drilled about 1902. Commercial production in the shallow shale oil section was obtained in 1919, yet the deep discovery well in the Weber sand was not drilled until 1933. It then stood capped for ten years though lack of transportation and market facilities, although capable of producing several hundred barrels per day of 32-gravity crude, until wartime demand forced the opening of a very large reserve amounting to several hundred million barrels.

Additional possibilities still exist in other known fields of the Rocky Mountain region for deepening or extending production, and numerous other cases could be cited of recent progress.

Current Deep Drilling

Exploration in the deeper parts of the wide sedimentary basins of the Rocky Mountain area is now going on vigorously. First results of deep drilling in those areas have disclosed valuable oil and gas production at Church Buttes in southwestern Wyoming and at Worland and Neiber Domes in the southern Big Horn Basin. There have been some disappointments as well, as in the three deep dry holes drilled in the northern part of the Powder River Basin in southeastern Montana, but these three tests cannot condemn all of the many thousands of square miles in a vast basin which has three of the largest oil fields of Wyoming on its margins.

Deep drilling on the flanks of the Big Sand Draw structure in the Wind River Basin of central Wyoming has had very favorable results, and the deeper parts of the Laramie, Hanna, Washakie and Uinta Basins are virtually untested. The Green River Basin has barely been scratched and the Denver Basin of Colorado and southern Wyoming has been inadequately explored. The San Juan Basin of northwestern New Mexico is now undergoing intensive surface and geophysical investigation and the first large-scale explorations are being made in the Black Mesa Basin of northeastern Arizona.

In addition to its oil and gas reserves,

OIL AND GAS FIELDS OF THE ROCKY MOUNTAIN REGION

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the Rocky Mountain region contains more than half the coal resources of the U. S. and an oil shale reserve that may prove to contain many times the amount of the petroleum resources now known.

Montana

Cut Bank field on the west flank of the Sweet Grass Arch in northwestern Montana attracted considerable attention in 1947 because of the discovery of three small Madison lime pools in the northern end. Production is from the upper portion of the thick limestone section and is characteristically spotty, but other small Madison lime pools may be expected within the margins of the field as a result of deepening operations below the Jurassic sands from which the major portion of the present output is obtained.

There is a considerable amount of shutin and to some extent undeveloped gas production at the northern end of the Cut Bank pool. A gas line was at one time projected westward to Spokane, but was not constructed because of lack of sufficient reserves. Since that time additional sources of gas have been developed a few miles east at Utopia and Devon.

The Texas Company completed Lass 2 in the Utopia field as a 20-million-foot gas well early in 1946. The well produces from the Devonian horizon, productive of oil in the Leduc area of Alberta. This is a new producing horizon for Montana and adds its possibilities to those of the Upper Mississippian Big Snowy group as largely untested strata of considerable promise.

East of the Utopia gas discovery is a series of small structures which extend across northern Montana to the large Bowdoin Dome and shallow gas field in the northeastern part of the state. The Texas Company has a continuing program for the exploration and development of these structures. The same company recently completed a deep dry hole on the large Bowdoin Dome, in the center of the shallow gas field. Other companies have taken extensive blocks in northeastern Montana and have carried on widespread geological and geophysical surveys.

Southeast of the Bowdoin Uplift is the broad Blood Creek-Sheep Mountain syncline. Surface beds in this area are uppermost Cretaceous and lower Eocene continental deposits of complex stratigraphy and slight dip. Several major companies have conducted coordinated geological and geophysical surveys of the area and additional drilling may be expected. Magnetic surveys indicate a pattern at variance with the regional trends of the surface rocks, presumably due to pre-Cambrian trends, but possibly affecting the Paleozoic structure.

The Sheep Mountain Syncline is bordered on the east by the 100-mile-long, northwestward trending Cedar Creek Anticline which has extensive shallow gas fields producing from Upper Cretaceous sands along its crest. Deep drilling on the southern and highest portion of the anticline produced strong showings of black oil from Mississippian and Devonian (?) beds but failed to find commercial production. The deep drilling here gave the first indication of thick Upper Mississippian beds in the basin which were not represented on the nearest outcrops at the margin of the area. The possibilities of Devonian production have not been fully explored.

No exploration has taken place in the deep Williston Basin of North Dakota since the drilling of the Nesson Anticline, but it is not likely that so large a sedimentary basin is being ignored in the present widespread search for oil.

A large, steep-sided, flat-topped arch extends eastward from the Big Snowy Mountains of central Montana, terminating in the large, rounded Porcupine Dome. On the north rim of the arch is a series of small faulted anticlines ending in the Cat Creek structure. Recent deepening of wells in the eastern part of the Cat Creek structure from the shallow Cat Creek sand at the base of the Cretaceous at about 1100 feet to lower Morrison and Ellis sands of Jurassic age at about 1400 feet resulted in the development of two small but prolific pools. This is a small operators' paradise because of the shallow depths, large initial flows and high gravity oil. Some of the small structures along the Cat Creek trend have not been drilled below the Kootenai (Cretaceous) sand and still present opportunities for inexpensive deepening operations. On the southern rim of the arch a deep test at Devil's Basin failed to find production in the Jurassic, the Big Snowy (Mississippian) or Devonian beds. The recent discovery by The Texas Company at Ragged Point is on this arch.

Exploration in the northern part of the Powder River Basin has been disappointing. Three deep wells have been drilled, to date, by Stanolind Oil & Gas Company at Coalwood, The Pure Oil Company at Maxwell Butte, and a deep test by the Union Oil Company at Beaver Creek, in Wyoming.

Wyoming

The Wyoming portion of the Powder River Basin has been the object of intensive geological and geophysical investigation for three years. The activity is centered around the town of Gillette in the northern part of the basin. A large number of blocks have been assembled, chiefly on geophysical evidence, although there are some signs of folding in the Tertiary beds. The depth to possible producing sands and the distance from producing fields have led to prolonged consideration before drilling, but a test now being drilled by The Texas Company on its Adon block has had highly encouraging showings of oil.

At the south end of the basin, a deep test by The Carter Oil Company northeast of the town of Douglas went to nearly 12,000 feet but failed to find production. Gas and shallow oil were discovered a number of years ago in continental beds of Oligocene age in core holes in this area, near Shawnee, but the Carter test, after extensive geophysical exploration, did not locate the source. Large faults with southwesterly trends extend from the north flank of the Lance Creek field toward the Shawnee area, where the Carter well was drilled.

A recent discovery is the shallow Mush Creek field on the eastern margin of the Powder River Basin where active development is rapidly extending the producing area. Like Osage and the Upton-Thorndyke fields, this is a stratigraphic trap without surface structural evidence to guide exploration.

The Powder River Basin, with Salt Creek, Big Muddy and Lance Creek fields about its southern border and a number of small fields along its eastern margin, undoubtedly is a petroliferous province, but the size of the structures mapped by seismic methods in its center has been disappointingly small, and much of its western margin is surprisingly lacking in foothills folds and in producing oil fields.

The deep and sharply folded Big Horn Basin is rimmed with producing oil fields from which comes a wide variety of crude oils, ranging from heavy black asphaltic crude to distillate and natural gas, some nearly free from sulphur, some excessively "sour."

The extensive development of the Pennsylvanian Tensleep sand at Elk Basin was the first large expansion of Wyoming production caused by wartime demand, but many other black oil fields had expansion for the same reason. Important extensions to the Elk Basin field recently have been made and the Seaboard wildcat at Silver Tip, west of the field and deeper in the Big Horn basin, is drilling ahead after encouraging shows were found in the Phosphoria and Dakota. Additional drilling and deepening in known fields accounts for a considerable part of Wyoming's increase in production. Frannie, Oregon Basin, Hamilton Dome, Half Moon, Fourbear, Kirby Creek, Zimmerman Butte and other fields all were deepened or redrilled. Gebo is another wartime development of a structure long known and only partially tested.

Intensive geophysical exploration in the Tertiary covered areas in the center

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of the Big Horn Basin resulted in the drilling of deep tests by The Carter Oil Company at Five Mile (dry in the Frontier sand); by The Pure Oil Company at Worland or River Dome, where commercial production was discovered in the Embar lime; and by General Petroleum Corporation at South Fork and Sand Creek, producing from the Embar lime and Frontier sands. A deep test on Neiber Dome resulted in a large oil and gas well with an excessively high sulphur content, approached only by that at Pure's Worland field.

The Burlington Anticline, plainly defined on the surface but situated even deeper in the basin, and other known structures in the deeper parts of the Big Horn Basin, have not been tested. A number of the smaller structures on the margins of the basin have not been tested through all known horizons, though all have been drilled to shallow depths.

Exploration in the Wind River Basin has not been as intensive as in the Big Horn Basin, although the old fields along its western margin were among the first drilled in Wyoming and the early plainsmen skimmed oil from seeps near Lander to grease the wheels of covered wagons in "Forty Niner" days.

Winkleman Anticline, at the north end of the Dallas-Derby-Lander-Plunkett line of folding, is a recent development, as is Sheldon Dome. Steamboat Butte likewise is a recent discovery which owes its development to recent seismic surveys and persistent testing in an area only partially revealed by surface outcrops. Little Dome, a strongly faulted anticline well exposed on the surface, has not yet yielded a producing well although two of three abandoned tests found saturated Tensleep sand.

The northwestern extension of the Wind River Basin was not well known, geologically, until a few years ago, when a mountain range not previously known and partially buried under Tertiary volcanics was mapped for 80 miles along the northwestern margin of the basin. Only last year the Dubois structure, a sharply folded and faulted anticline on the edge of the range, was drilled as the first successful test in this district.

In the eastern part of the Wind River Basin, important recent developments have been the drilling of the deep Beaver Creek field (known many years ago), the finding of oil deep on the flanks of the Big Sand Draw gas field, and the interesting but disappointing discovery at Lysite that the sedimentary section, particularly the Mesaverde formation, was several thousand feet thicker than had been estimated from surface work and the underlying sands correspondingly deeper.

Poison Creek structure was drilled and found dry in 1945. Other structures in the southeastern part of the Wind River Basin were scheduled for testing in 1947 and 1948.

No wells have been drilled for oil in the deep and narrow Hanna Basin. There are several fields, including the prolific but short-lived Medicine Bow pool on its southern border, and several small gas fields on the eastern margin.

Laramie Basin Developments

Recent developments in the Laramie Basin include the discovery of Tensleep production in the Quealy field (an old field deepened), and at Herrick (a new discovery), and the development of shallow Muddy sand production at Big Hollow on a long-known structure. Still another test on the line of folds along the west side of the Laramie Basin, at Seven-Mile between Quealy and the Rock Creek field is showing promise at the time of writing. The deeper portions of the Laramie Basin have not been tested.

A deep V-shaped valley between the Medicine Bow and Park Ranges, south of Hanna Basin, underlain by a thick sedimentary section and deeply covered by gravel, is known as the Saratoga Embayment. At the open end of the valley the trough is closed by a series of sharp folds. Several wells have been drilled in the valley with encouraging shows but no commercial production has been found.

Green River Basin, with its 18,000 square miles of surface largely covered with Tertiary deposits, and with a maximum thickness of sedimentary rocks exceeding 30,000 feet, has been the seat of much geophysical and geological activity since the discovery of the deep Church Buttes field in 1946.

Strong folds west of the overthrust fault zone that marks the western margin of the basin have not been tested. The folded sedimentary rocks of the Salt Range belt west of the Green River Basin extend for a considerable distance into southeastern Idaho and represent potential oil territory that has had little consideration.

The northwestern extension of the Green River Basin is now receiving its first tests at Granite Creek and at Warm Springs anticlines. A little farther south is the deep test of The California Company west of Pinedale which ended in Tertiary beds at 10,000 feet, but had strong gas shows near the bottom of the hole.

Lost Soldier, the most prolific oil field in Wyoming, is at the extreme northeast corner of the Red Desert Basin Crooks Gap, Spring Creek and Wertz fields are nearby. The presence of these oil fields has encouraged a number of attempts to extend production farther west by drilling such structures as Bison Basin, Antelope, Barren Butte and Great Divide. Of these, only Bison Basin has yielded encouraging shows of oil and gas. The possibilities of deep production from the Lost Creek fault zone, Horsetrack Anticline and other unnamed structures in Red Desert have not been explored. A little farther west a test is under way at Pacific Creek, south of the Continental fault, and another projected deep test at Oregon Trail was abandoned because of mechanical difficulties.

In the southeastern portion of the basin several attempts to find commercial production along the Cherokee Ridge-Baggs line of folding east of Hiawatha and Powder Wash fields have failed to disclose oil or gas in Upper Cretaceous beds, and only minor amounts of gas in the Tertiary formations that produce at Powder Wash. No very deep tests have been drilled, nor have the surface structures deeper in the basin at South Desert and Barrel Springs been tested.

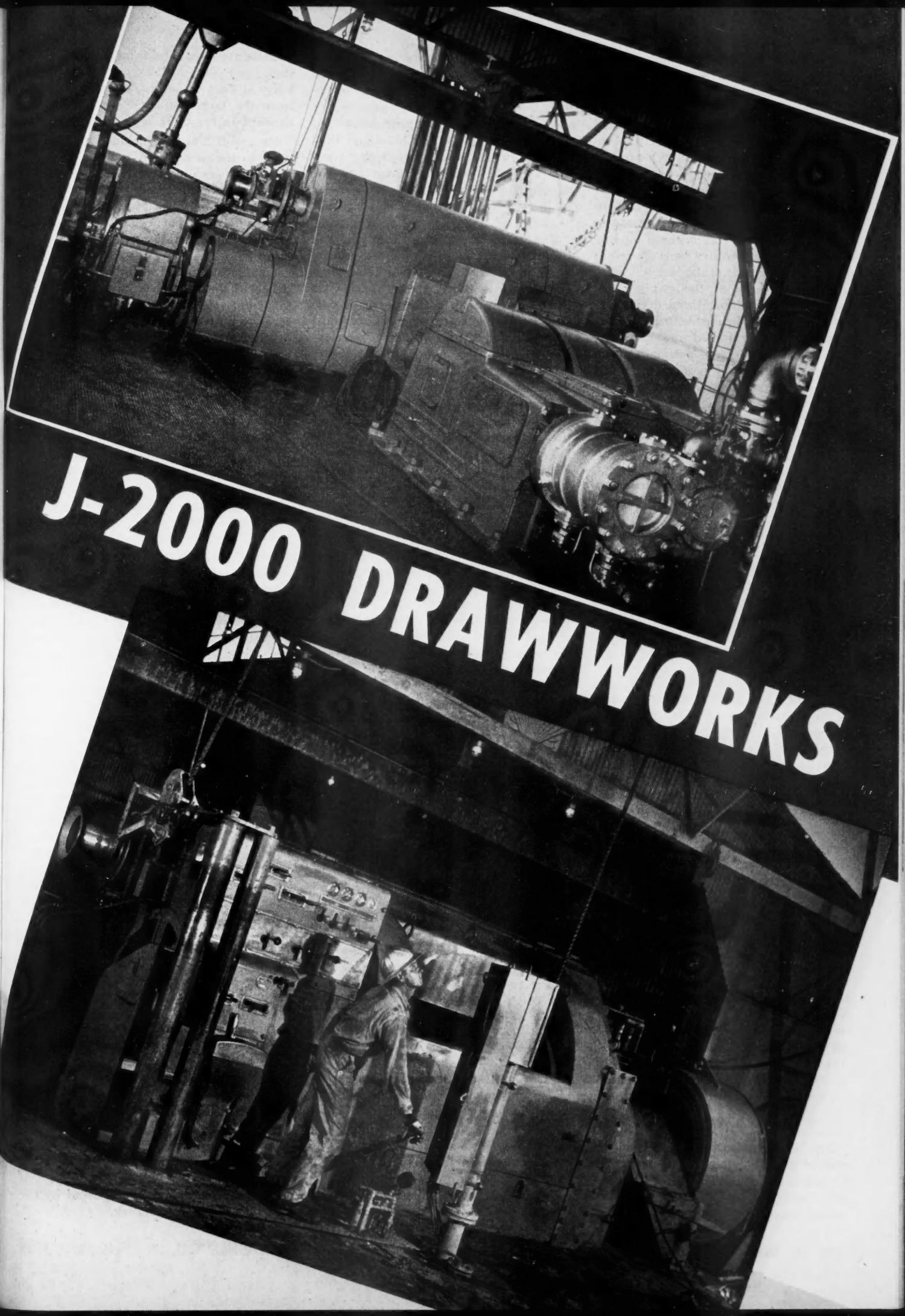
In the center of the Green River Basin the huge Rock Springs Up-lift has yielded only gas and small amounts of oil. The small Table Rock structure on its east flank is a recent discovery as a small gas field.

Colorado

The only new discoveries of oil in Colorado in recent years are at Elk Springs and Clarks Lake, but deepening and additional developments of such fields as Rangely and Wilson Creek have quadrupled the state's production. There was only limited development at Wilson Crook, first drilled in 1921 and brought into commercial production in 1938 until wartime demand in 1943 brought about a program of expansion that made it the second largest field in Colorado.

Following the discovery of deep production in the Rangely field, the smaller structures on the south flank of the Uinta Mountains have been actively explored, and one of them has come into production at Elk Springs. This is the only place where the Weber sand has been found productive since its discovery at Rangely field. The Continental well at Elk Springs was the third test on a relatively small structure, but the first to the Weber sand.

Deep tests have been drilled to the Weber sand in several of the fields on the eastern end of the Uinta basin and on the southeast extension of the Green River basin where they are separated by the narrow arch of Axial Basin. Meeker, Iles, Moffat, Beaver Creek, Yellowjacket and Poose Creek structures were drilled without favorable results. It was found that the shoreward phase of the Weber sand along the mountain front was not a satisfactory reservoir rock, re-


J-2000 DRAWWORKS

ducing the possibilities of finding Pennsylvanian production at shallow depth in the mountainward folds.

The current campaign of drilling in northwestern Colorado is concerned with exploration of structures producing chiefly gas. Two structures producing small amounts of gas from Tertiary sands (Wasatch) have been drilled deeper; White River to 7000 feet in upper Cretaceous beds, and Piceance to more than 12,000 feet without finding the base of the Tertiary beds. A reecnt program is aimed at finding oil in a zone at the base of the gas zone at Piceance. In addition, three deep wildcat wells were being drilled between Douglas Creek gas field and Rangely.

East of the Rocky Mountain front, careful seismic exploration outlined a small extension to the Wellington field and located a small new field at Clark's Lake. A few additional possibilities for similar pools remain to be tested.

Discovery of the Keyes pool in the Oklahoma Panhandle set off a new wave of exploration in southeastern Colorado based on the possibility of stratigraphic traps occurring along the eastern flank of the Sierra Grande Arch and the Las Animas Arch. The results of the first tests have emphasized the differences in structural relations and stratigraphic variations on the two structures, but so far have not resulted in successful production.

Several areas have been explored. The Sharples-Huber-Frontier group drilled three wells at Freezeout Creek. The Ohio Oil Company drilled two wells in the Two Buttes area, and Skelly Oil Company has completed six core tests in the Rattlesnake Buttes area.

Wells drilled farther north on the Las Animas Arch in east-central Colorado have only confirmed previous conclusions that the structures are small and the porosity low in the thin zones in Pennsylvanian limestone that carry persistent shows of oil. The deeper Paleozoic beds have not been shown to be petroliferous in this area.

Farther west, in the deeper part of the basin, there must be a transition zone between the marine Pennsylvanian limestone of eastern Colorado and the red shales and coarse arkosic sands of the Rocky Mountain foothills outcrops. That zone, when located, should have interesting possibilities as a reservoir for oil and gas similar to those of the Texas Panhandle, where arkosic sands interfinger basinward with Permian dolomites.

New Mexico

The deep, narrow Raton Basin just east of the mountain front in southern Colorado and northern New Mexico, has seen few tests, one on the sharply upfolded western margin at Tercio, and a group of shallow tests at the north end in the Ojo-Oakview district where shows of oil are widespread but up to this time have nowhere been large enough for commercial production.

The complexly faulted Huerfano Embayment which lies between the steep fronts of the Wet Mountains and the Sangre de Cristo Range and opens southward into Raton Basin has not been tested.

The northern margin of the San Juan Basin makes a broad arc across southwestern Colorado. Much of the recent exploratory activity in the basin has been concentrated in the northern portion, which is also the deepest and most sharply folded part. Recent developments include a minor oil discovery in Colorado and a major gas development just across the line in New Mexico.

The small oil development is on the Chromo anticline which lies high on the Uncompahgre-San Luis arch and has been tested by approximately a dozen wells, one of which drilled from Jurassic Entrada sandstone into quartzite of Cambrian or pre-Cambrian age. A shallow test, located well down from the high point of the surface structure, found oil in the Mancos shale at about the Niobrara (?) horizon and near an igneous dike. Unfortunately for the requirements of theory, the dike was downdip from the oil accumulation and did not act as a barrier to upward migration. Only unimportant shows of oil have been produced from the Dakota sand at this locality. There is a marked overlap of pre-Dakota formations against the buried pre-Cambrian ridge, but flank tests have not been made.

The major gas development is on the western end of the San Juan Basin arc in southern Colorado at Barker Dome, which is a large and well-known structure. Deep drilling on Barker Dome has disclosed large gas reserves of very "sour" gas in the Pennsylvanian at depths below 8000 feet.

There is no production of oil or gas in the 75 miles between Barker Dome and Chromo Anticline. Numerous tests to the Dakota sand at Red Mesa southwest of Durango have yielded shows of oil and gas. None of the Red Mesa wells has gone deeper than the Morison formation, and the smoothly sloping terraces of the area should be favorable terrain for seismic exploration.

Utah

The western portion of the Uinta Basin in northeastern Utah is the principal center of geological activity in that state, with many geologists and several geophysical crews at work. Shallow exploration in the early 1920's developed a small gas field at Ashley Valley and several shallow tests were drilled near the town of Vernal. Two of these are of particular interest because they were designed to test the possibility of fluid oil accumulating down dip from the large asphaltic sand deposits exposed in the cliffs west of Vernal.

Recent drilling has included a shallow test on the small fold east of Ashley Valley, a deep well on the basinward side of the South Flank fault, just west of the town of Vernel, and two tests 12 or so miles west of Vernel, based on a combination of stratigraphic and seismic information. To date the recent drilling campaign has found no oil, but the evidence of the numerous large seeps, the gilsonite veins, the presence of structures untested to more than shallow depths, and the stratigraphic evidence all are favorable to the eventual discovery of oil. There is a striking contrast between the numerous fields in the Colorado side of the Uinta Basin and the virtual absence of production in the rest of the same province.

Deep tests also have been drilled on some of the structures west of the Uinta Basin, such as the deep well on Farnham Dome, on the north flank of the San Rafael Swell, additional development of the helium-bearing Woodside structure, a shallow oil discovery of small importance on Harley Anticline, and a current test on the Gordon Creek (Last Chance) structure. The enormous Circle Cliffs structure has been leased recently, although tested many years ago by a well that penetrated most of the sedimentary section. Discovery of production on any of the large structures of the western Uinta Basin, or on the High Plateau area to the southwest will lead to close examination of the possibilities of some of the lesser folds of the area. All of southwestern Utah and much of northern Arizona is underlain by a thick succession of Paleozoic limestones and sandstones. Oil was found many years ago in southwestern Utah and in the southeastern corner of the state, proving that the sediments are capable of producing oil in commercial amounts under the right conditions.

Recent Exploratory Trends

The Rocky Mountain region is unique among the nation's petroliferous provinces in that surface geology still plays a major role in the exploration programs of most of the operators now active in the area. In the early days of Rocky Mountain development most of the "textbook anticlines" were mapped and drilled to the shallowest possible producing horizon. The emphasis on current geological mapping has shifted to the Tertiary basins and belts of older rocks which were too remote or rugged to have been completely covered by the earlier exploratory work.

Application of Pumping Equipment

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Emsco Derrick & Equipment Company

A SURVEY of various factors which affect the economic life of pumping equipment, pointing out the basic points for analysis of the lifting problem before specifying the size and type of units installed. The survey also evaluates the effect of various factors as shown by performance of equipment already installed.

THE most economical pumping installation is one representing the minimum investment which will produce a well to completion with the lowest unit operating cost. While this axiom is self-evident and expresses the desire of every engineer charged with the responsibility of applying production equipment, it represents a very difficult goal to achieve.

The problem of applying production equipment is complicated by a number of indeterminate quantities such as ultimate fluid level, ultimate water production and desired production rates. If a sufficient amount of production data on the well is available, it is possible to estimate some of these factors with reasonable accuracy, providing all other conditions remain constant. If the assumed conditions are varied, the calculated results may be in error.

Pump Plunger

The first consideration in the selection of pumping equipment for a well is pump plunger size, because the plunger size is the key factor in determining the magnitude of the load imposed on the entire pumping system. In general, the plunger size should be the smallest which will produce the desired production in the most economical period of time. When selecting plunger size, some consideration must be given the length of surface stroke and pumping speed. As experience has shown that maximum rod life is obtained with low rates of pumping speed, relatively long strokes and slow rates of pumping speed should be considered. Maximum rod life is obtained under these pumping conditions, because in general sucker rod life is a problem in fatigue. If a member is subjected to a varying load which induces stresses in excess of the endurance limit of the material in the member, the member will fail in fatigue after some fixed number of stress applications. As sucker rods fail in fatigue, it is reason-

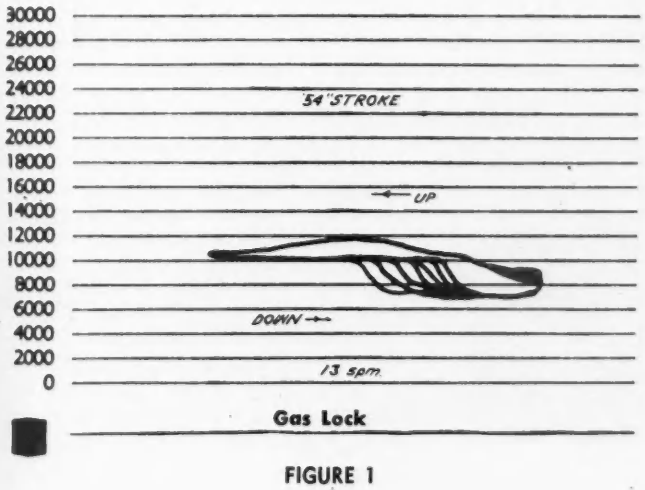


FIGURE 1

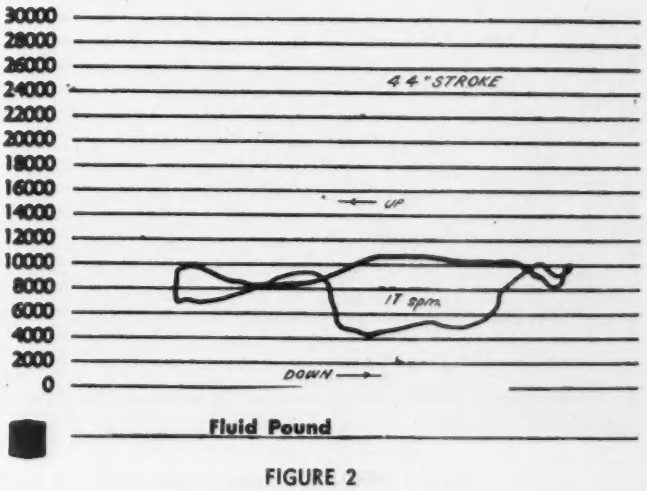


FIGURE 2

able to assume that at some point the rod is subjected to a stress in excess of its endurance limit. Therefore, this sucker rod is good only for a given number of load applications, and the most economical way to use this rod is to obtain the maximum work from each load application. Within reasonable limits this result can be obtained by using a relatively long stroke and a low number of strokes per minute. While the term relatively long stroke is indefinite, it is thought that the conventional pumpers on the market at this time offer stroke lengths which will attain this end, if they are used to capacity.

Large Gas Producers

In the case of wells producing large quantities of gas, the longer strokes have the additional advantage of helping to prevent gas locking of the pump. This effect is the result of the increased pump displacement with the pump clearance volume remaining practically constant. The dynamometer card in Figure 1 shows the usual effect of a gas-locked pump on the sucker rod load. In this dynamometer card, it will be noted that the sucker rods are subjected to mild impact loads on the down portion of the stroke. As this impact load induces additional stresses into the sucker rod string, it reduces its life. Also, gas lock wastes power, because it decreases the production efficiency of the pumping system.

In the case of a well with an extremely low fluid level and a low productivity index, it is desirable to use a pumping rate which will keep the fluid level at a minimum but will not pump the well off. If the well is pumped off, the pump will not fill with fluid each stroke, and it will pound fluid. The dynamometer card in Figure 2 shows the usual effect of pounding fluid on the sucker rod load. In this dynamometer card, it will be noted that the sucker rods are subjected to severe impact loads. These impact loads induce very severe stresses in the rod string and make it impossible to properly counterbalance the surface pumping equipment. Admittedly, a pumping rate which will never produce fluid pounding in a well of this type will not keep the bottom of the hole pressure at an absolute minimum, and therefore will not result in the maximum theoretical production, but it will result in the maximum overall production because shutdown time for pump, rod and surface equipment repairs will be kept at a minimum.

Once a logical pump size has been selected, the pumping speed must be selected. To assure minimum sucker rod loads and maximum rod life, the pumping speed selected should not be synchronous with the natural frequency of vibration of the rod string. The natural frequency of vibration of the rod string can be determined by the following formula by Slonneger[1]:

$$F = \frac{237{,}000}{D}$$

Where:

F = Natural frequency, in cycles per minute.

D = Length of rod string, in feet.

The family of curves shown in Figure 3 is based on this formula, and the solid lines represent desirable or non-synchronous pumping speeds.

After the plunger size and pumping speed have been selected, the approximate production can be determined from Figure 4. This chart is based on 80 percent pump efficiency and that over-travel, and rod and tubing stretch have been neglected. Rod and tubing stretch can be evaluated by the following formula:

$$\text{Rod Stretch} = D^2 \left[\frac{12 \times A \times W}{30} \left(\frac{1}{A_r} + \frac{1}{A_t} \right) \right]$$

Where: D = Depth to pump, in 1000 feet

A = Plunger area, in square inches

W = Weight of fluid, in pounds per foot

A_r = Area of rods, in square inches

A_t = Area of tubing, in square inches

As all of the factors enclosed by the brackets are constants, this formula can be reduced to depth in thousand feet squared multiplied by a constant. The constants for the more common rod, tubing and plunger combinations are shown in Table 1. Plunger over-travel can be determined by the following formula:

$$\text{Over-travel} = \frac{2 \times (D \times SPM)^2 \times L}{100{,}000}$$

Where: D = Depth to pump, in 1000 feet

L = Surface stroke length, in inches

Spm = Strokes per minute

This formula is represented in graphical form in Figure 5. The production values determined from the chart shown in Figure 4 can be corrected for over-travel and rod and tubing stretch with the formula:

$$\text{Production} = \frac{P\,(L + O - S)}{L}$$

Where: P = Production with 80 percent efficiency not corrected

L = Length of surface stroke, in inches

O = Over-travel, in inches

S = Rod and tubing stretch, in inches

Choosing Sucker Rod Size

After determining the plunger size, the pumping speed, and surface stroke, a tentative sucker rod size must be selec-

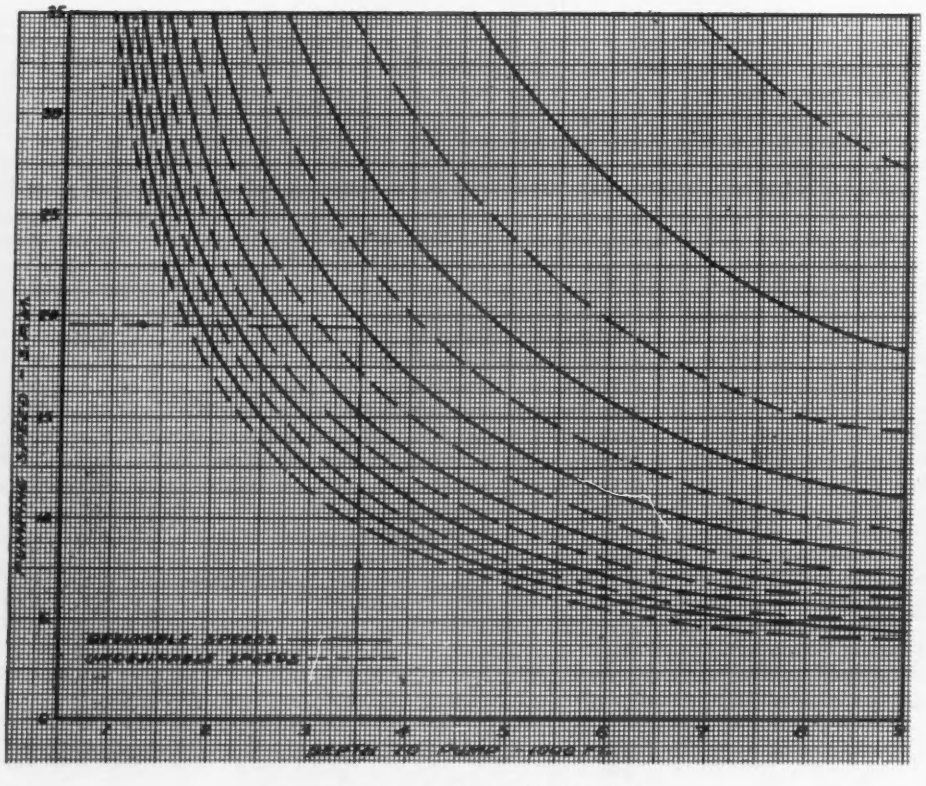


FIGURE 3. Pumping speed selection chart.

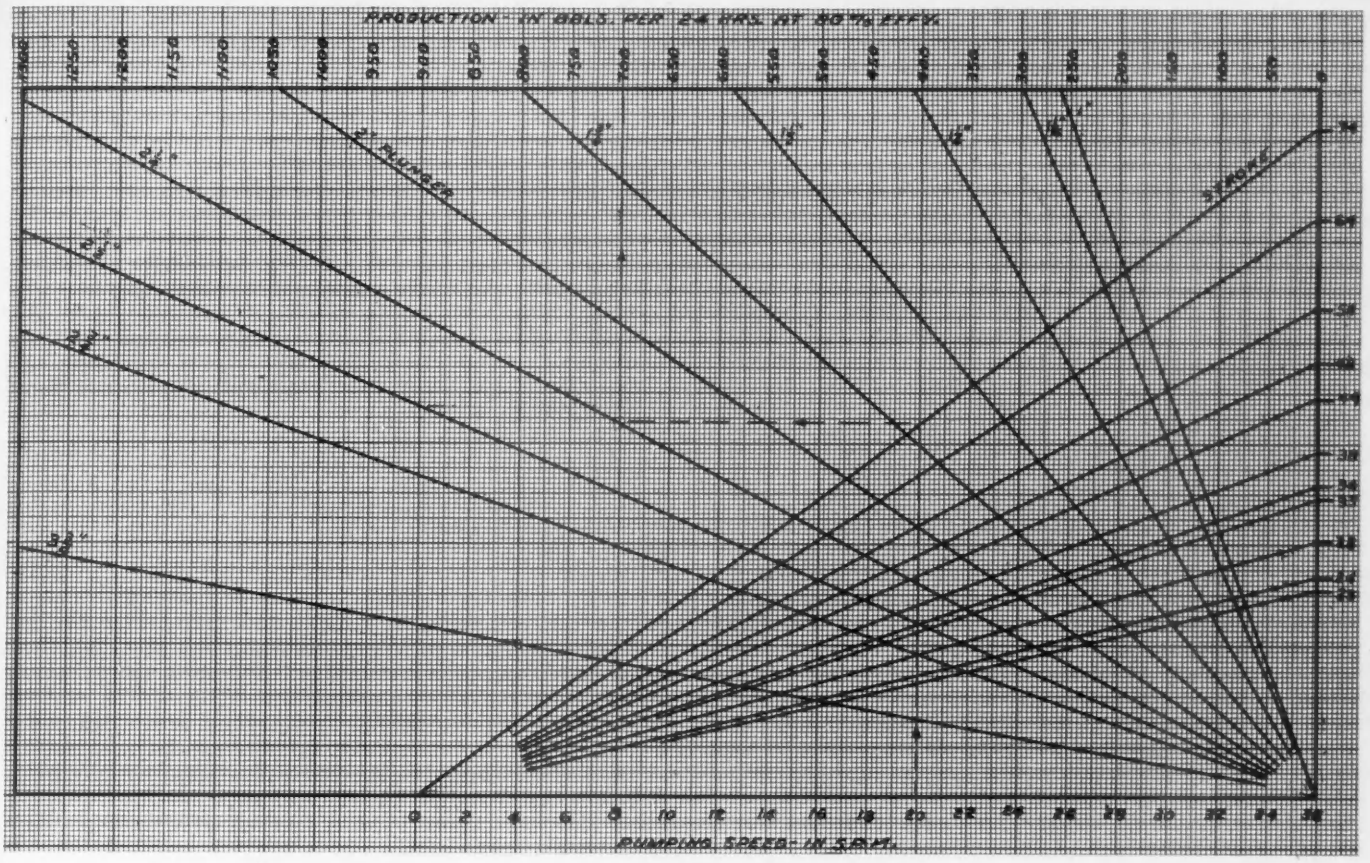


FIGURE 4. Production chart.

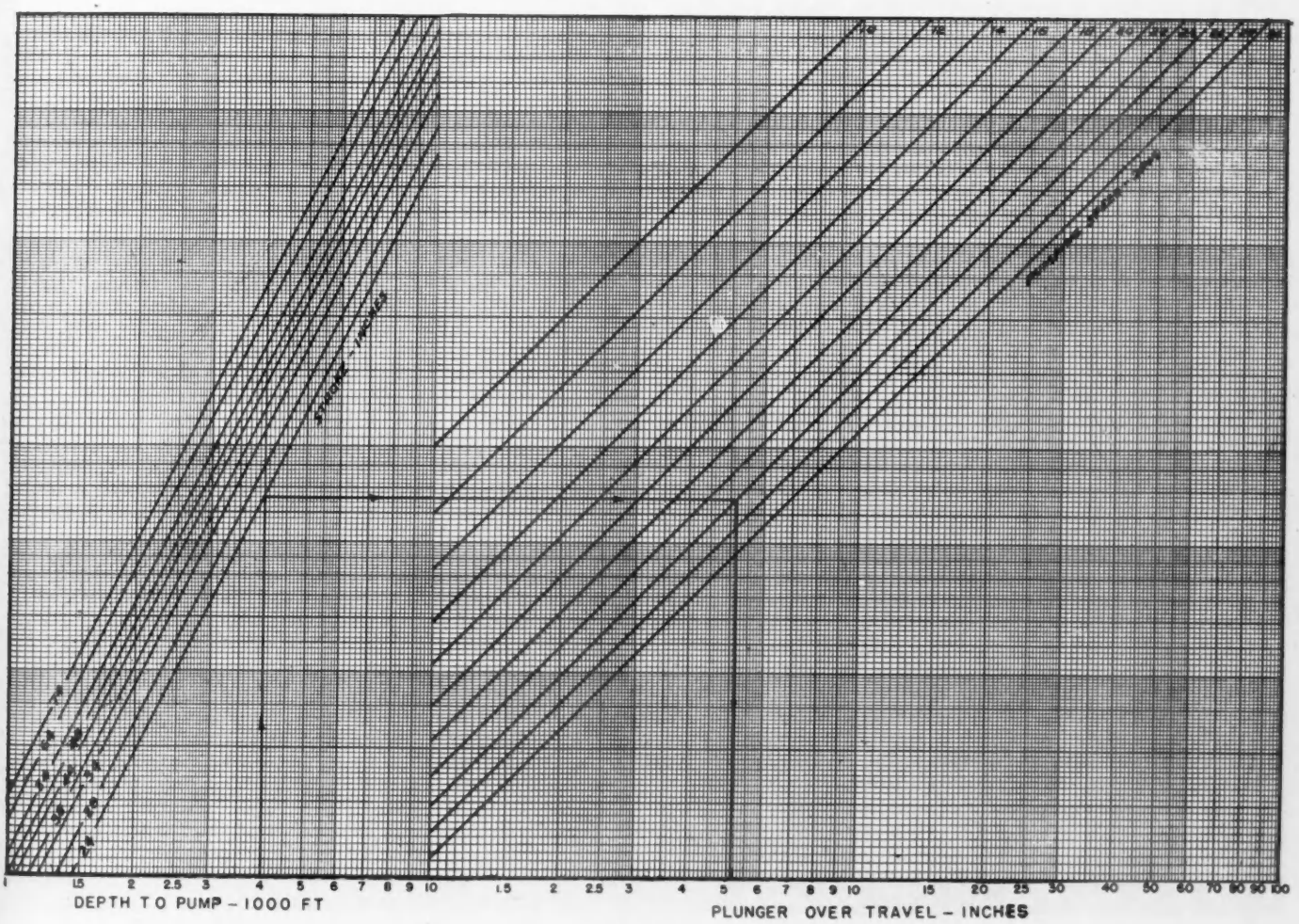


FIGURE 5

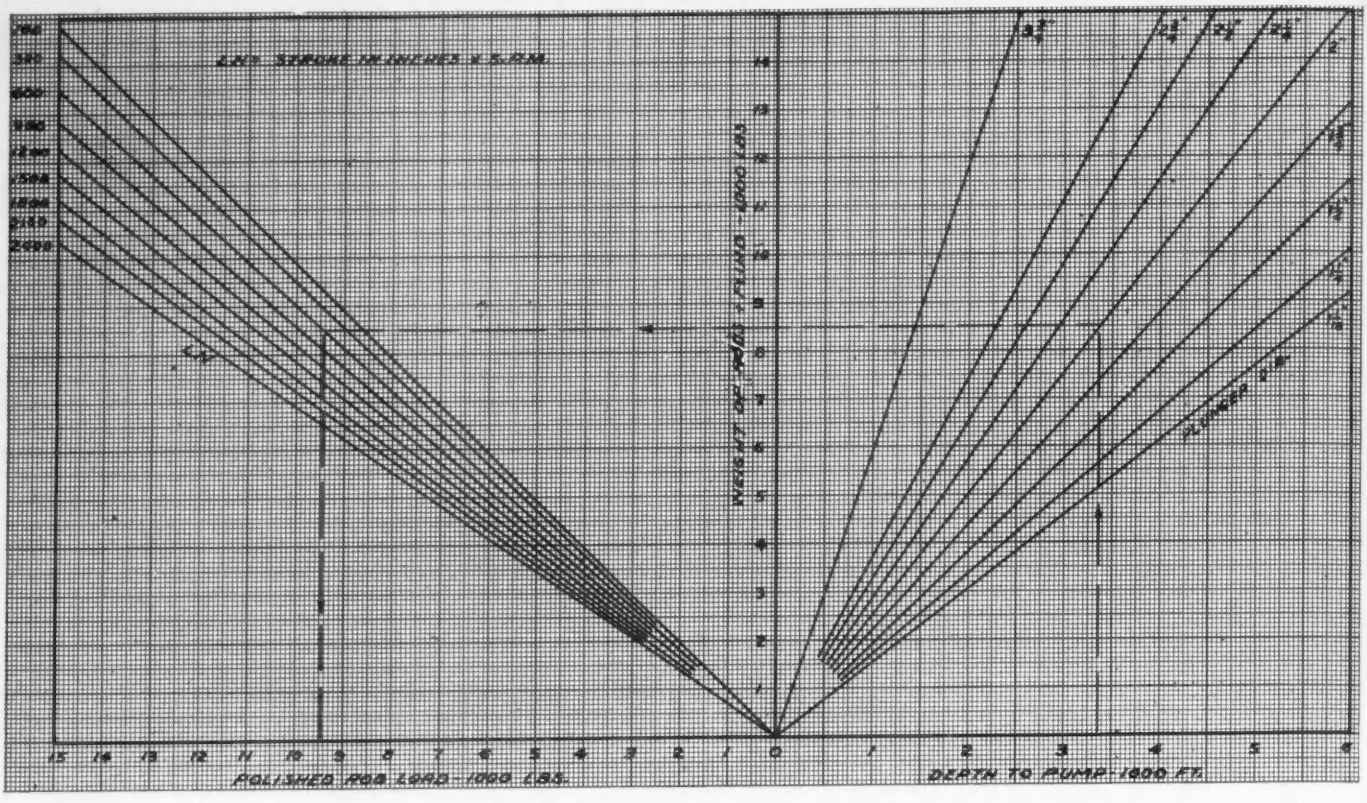


FIGURE 6. Well load determination chart 5/8-inch rods.

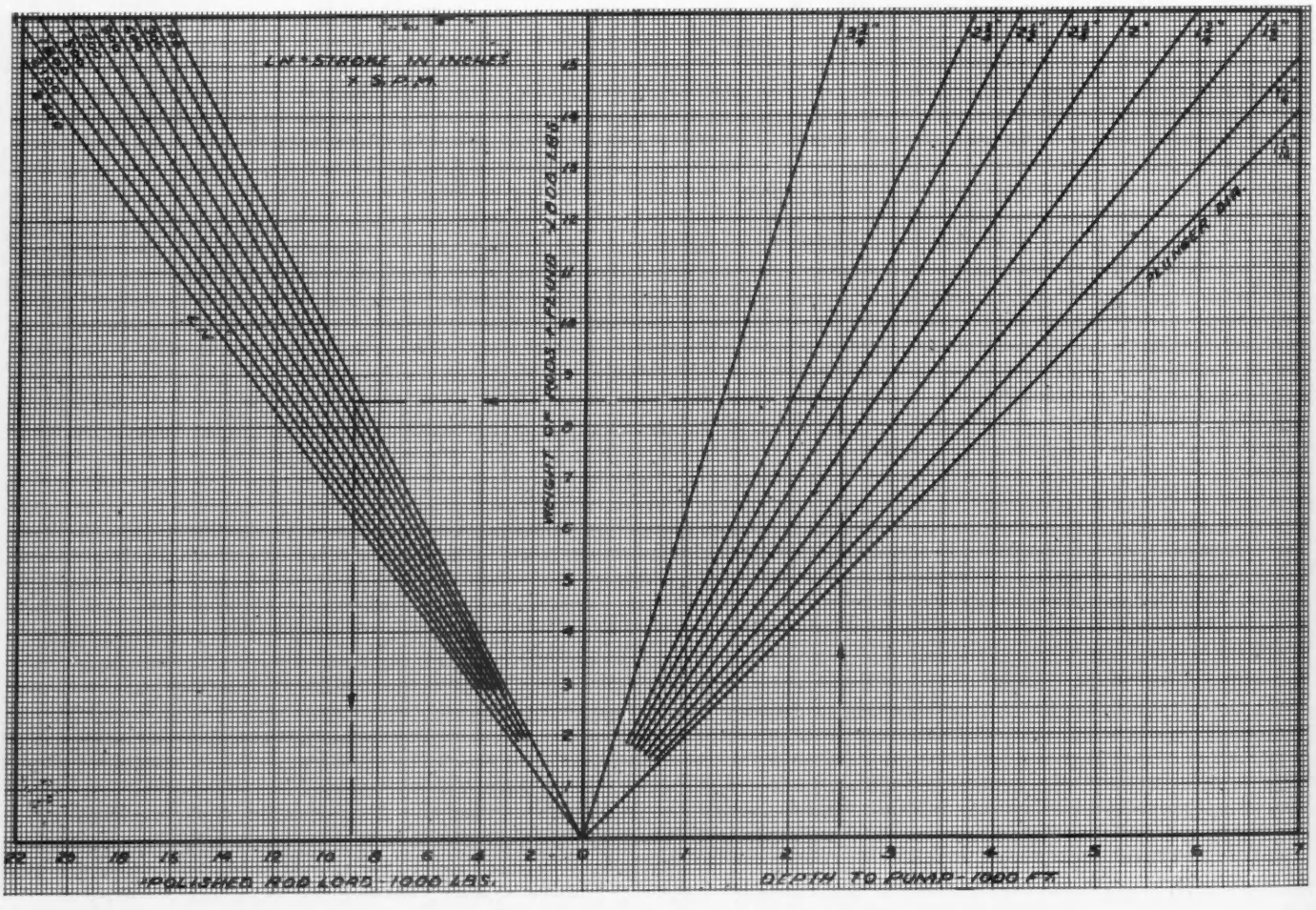


FIGURE 7. Well load determination chart 3/4-inch rods.

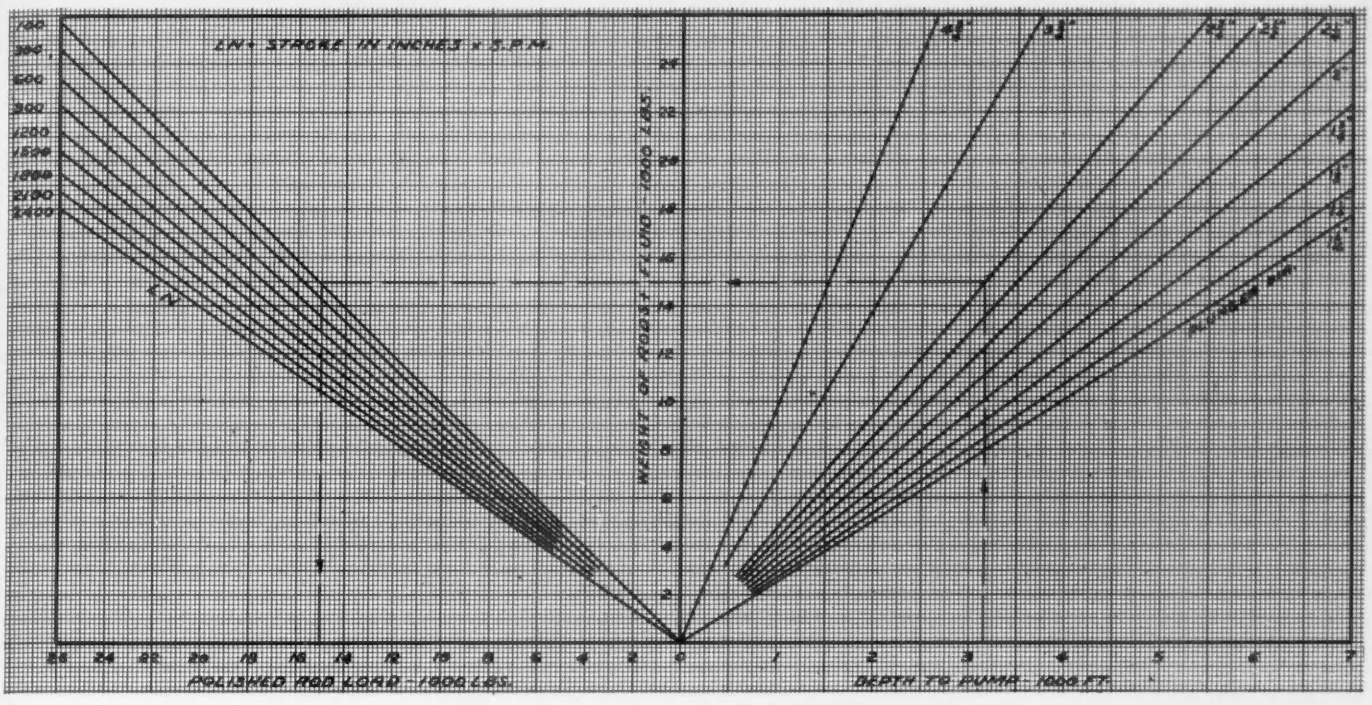


FIGURE 8. Well load determination chart ⅞-inch rods.

ted. This tentative selection should be based on current practice in the area and should be checked for working stress after the well load has been calculated. The sucker rod working stress should be based on the rod manufacturer's recommendation for the grade of rods used and the type of fluid produced.

The well load can be calculated by the following formula which is suggested by the API in API Standards 11E:

Table 1
Coefficient of Stretch "C"

Plunger Size	2" TUBING		2½" TUBING			3" TUBING			
	⅝" Rod	¾" Rod	⅝" Rod	¾" Rod	⅞" Rod	⅝" Rod	¾" Rod	⅞" Rod	1" Rod
1 1/16"	.54	.39	.52	.37	.28	.51	.37	.27	.22
1¼"	.75	.55	.73	.52	.40	.72	.51	.38	.30
1½"	1.08	.78	1.05	.76	.68	1.03	.74	.66	.43
1¾"	1.48	1.08	1.43	1.03	.78	1.40	1.00	.75	.59
2"	....	....	1.86	1.34	1.01	1.83	1.31	.98	.77
2¼"	....	....	2.37	1.70	1.29	2.32	1.66	1.25	.98
2½"	....	....	....	....	....	2.86	2.04	1.53	1.20
2¾"	....	....	....	....	....	3.46	2.47	2.31	1.45

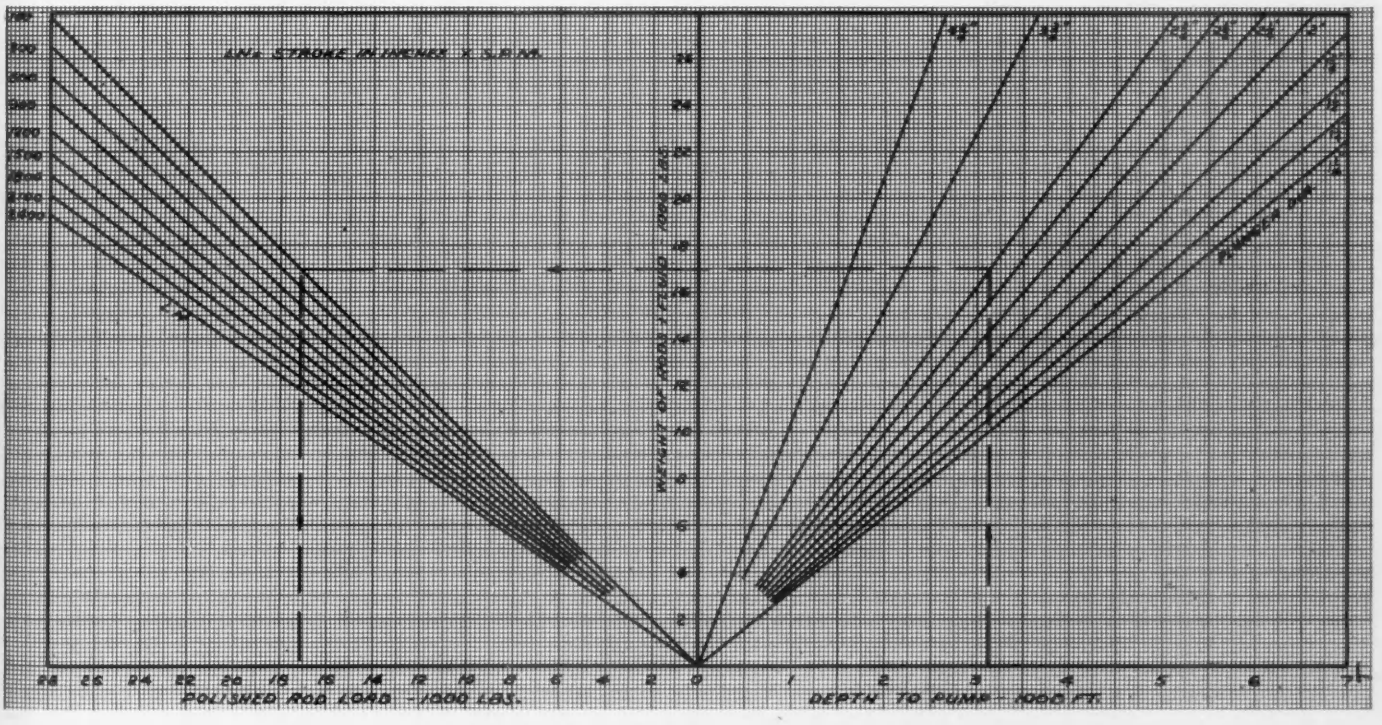


FIGURE 9. Well load determination chart, one-inch rods.

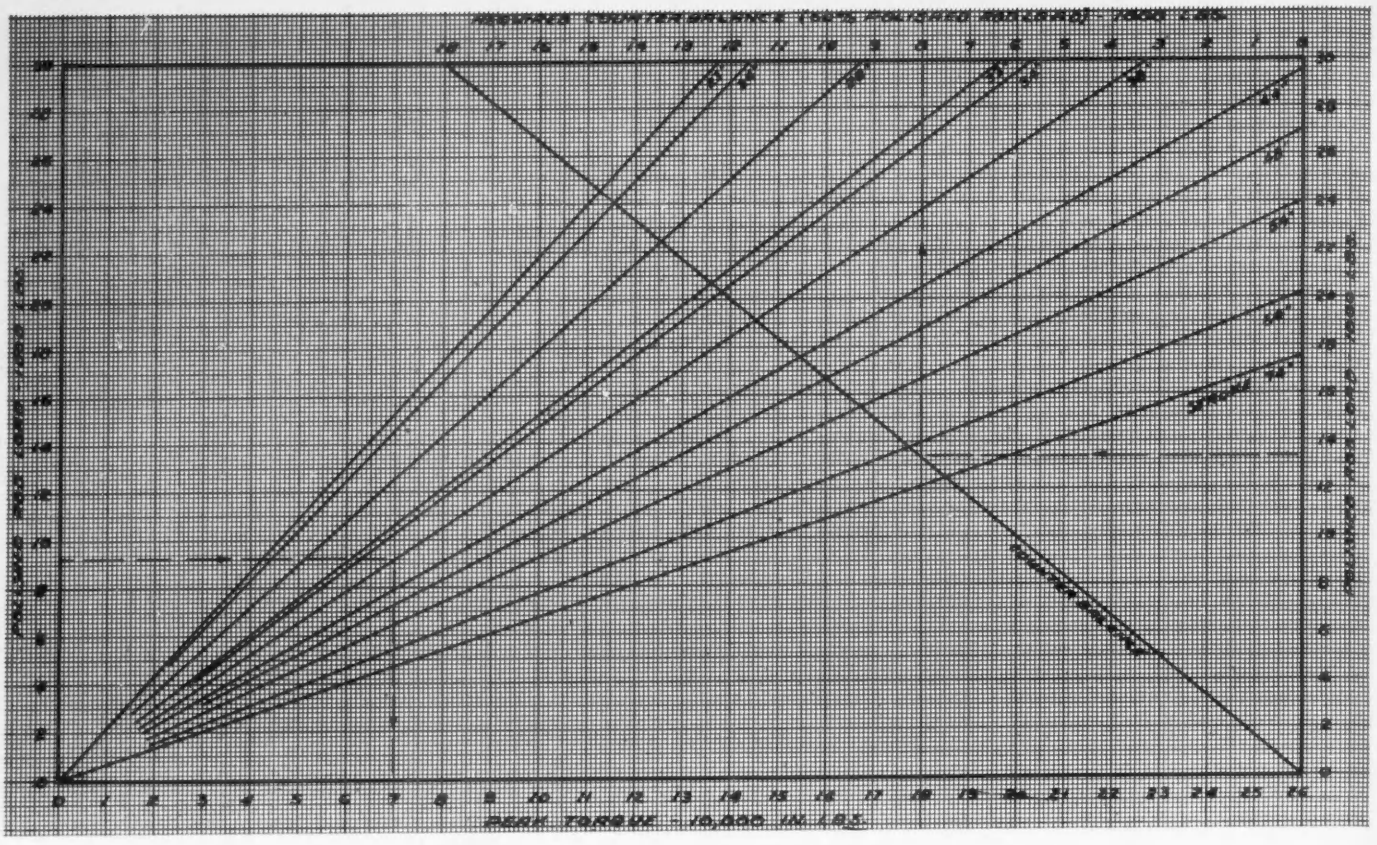


FIGURE 10. Peak torque determination chart.

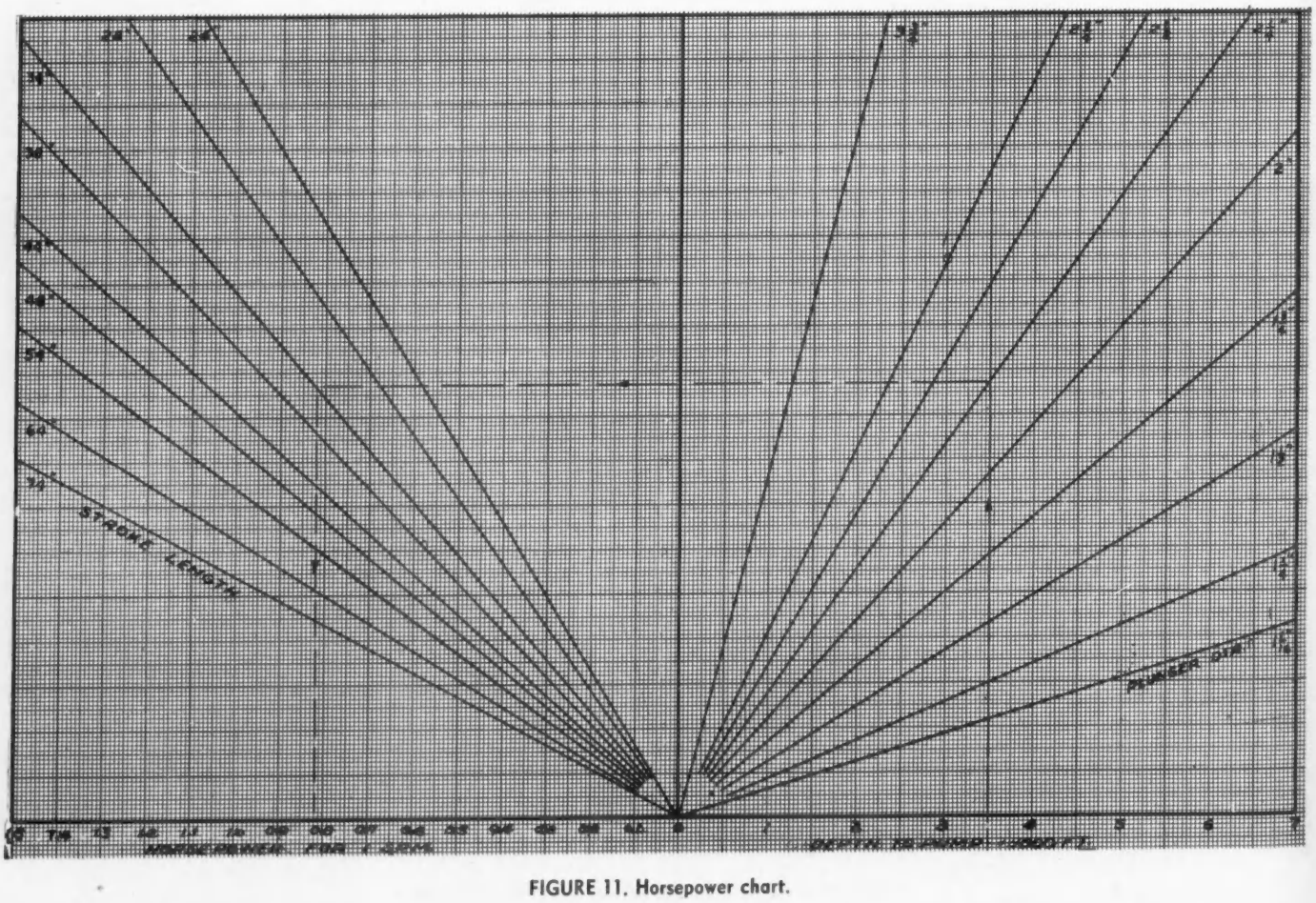
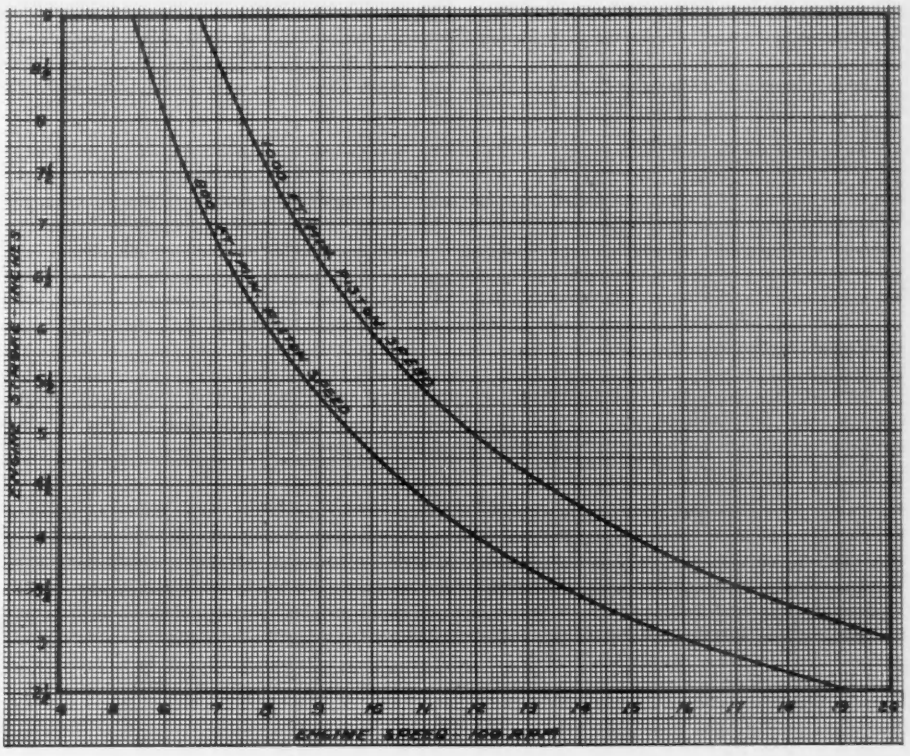


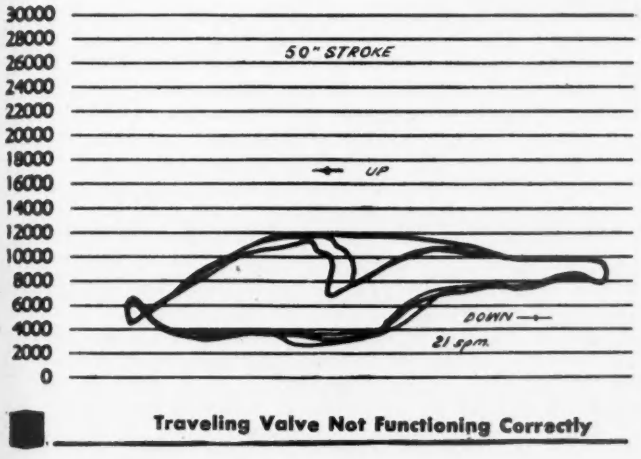
FIGURE 11. Horsepower chart.

FIGURE 12 (top right)

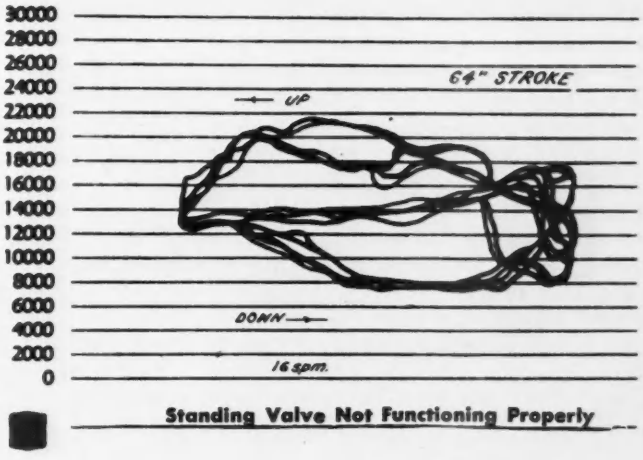
FIGURE 13 (lower left)

FIGURE 14 (lower right)





Traveling Valve Not Functioning Correctly



Standing Valve Not Functioning Properly

$$\text{Well Load} = \left(W_o + W_r\right)\left(1 + \frac{L \times SPM}{5400}\right)$$

Where: W_o = Weight of fluid (Sp. Gr = 1) on gross plunger area, in pounds
W_r = Weight of rods in air, in pounds
L = Length of stroke, in ins.
Spm = Strokes per minute

Graphical solutions of this formula for the common sizes of rods and pumps are shown in Figures 6, 7, 8, and 9.

Assuming that the well is to be fitted with a conventional unit pumper, the next problem is to determine its size. If satisfactory service is to be obtained from this equipment, it must be selected on the basis of peak torque and not horsepower. The peak torque method should be used, because all of this type machinery is designed to resist a specific maximum peak torque load. Due to the cyclic and variable nature of the connected load, the average horsepower requirement does not have a definite relation to the peak torque load. Using the accepted formulas for peak torque and average horsepower, it can be shown that when small plungers are used the average horsepower required is small when compared to the peak torque load. When large plungers are used, the average horsepower required will be large when compared to the peak torque load. The peak torque required to pump a given well can be estimated by the following formula which is suggested by the API in API Standards No. 11E:

$$\text{Peak Torque} = (W - C) \times \frac{L}{2}$$

Where: W = Calculated well load, in pounds
C = Counterbalance (can be estimated as 0.6W), in pounds
L = Stroke length, in inches

Graphical solutions for this formula and counterbalance requirements can be determined from the chart shown in Figure 10.

The problem of selecting the prime mover is in reality two separate and distinct problems. First, the type of prime mover must be selected. The prime mover can be a slow speed engine, a high speed engine or an electric motor. The type of prime mover will depend on a number of factors, some of which are as follows:

1. Fuel or power cost.
2. Type of lease labor available.
3. Cost of lease labor.
4. Minimum atmospheric temperatures and their relation to starting troubles.
5. Companys policies toward automatic operation.
6. Number of wells on lease.

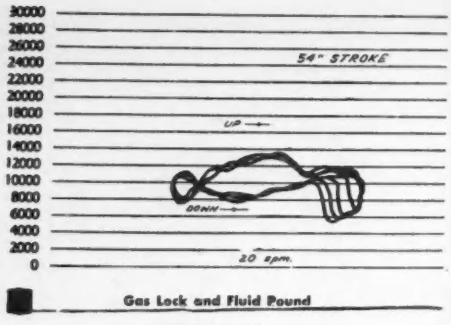


FIGURE 15

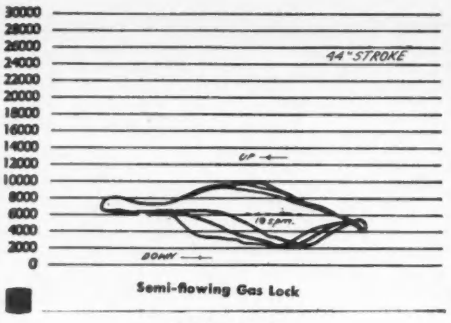


FIGURE 16

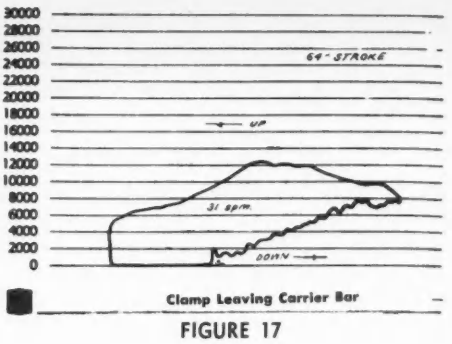


FIGURE 17

The horsepower required to pump a well can be determined by the following formula which is based on approximately 62 percent efficiency:

$$\text{Horsepower} = \frac{P^2 \times L \times SPM \times d}{728{,}000}$$

Where: P = Plunger diameter, in inches
L = Length of stroke, in inches
SPM = Strokes per minute
d = Depth to pump, in feet

The results obtained from the above formula represent the API engine horsepower as determined from the curve for the fully equipped power units as defined in API Standards 11C. If an electric motor is used as the prime mover, the results must be divided by 0.7 to obtain the motor horsepower required. In the case of the electric motor, this additional horsepower capacity is required to carry the pumping system through the peak torque points. It is not required in the case of an engine, because the engine rating has been decreased to accommodate these peak loads. Graphical solutions of this formula for 1 stroke per minute can be determined from Figure 11. The power required at any pumping speed can be found by multiplying the results obtained from this chart by the pumping speed in strokes per minute.

The power delivered by a high speed engine is a function of the engine operating speeds and its power capacity increases with speed. When initial cost only is considered, great savings can be made by operating the engine at high speeds, because smaller engines are required. However, following this practice may not result in the most economical installation, because the engine life may be materially decreased. In a recent paper by J. H. Fields[2] the maximum economical operating speed for multiple cylinder engines was defined as a piston speed of 1000 feet per minute, and 800 feet per minute for single cylinder engines. The engine speeds corresponding to these piston speeds can be determined from the curves shown in Figure 12.

As pumping depths increase, the static weight of the sucker rods becomes an increasingly important factor and means for reducing their contribution to the total well load becomes desirable. The conventional method for accomplishing this aim is to use tapered sucker rod strings composed of two or three sizes of rods depending on the depth. The usual practice is to consider tapered rod strings composed of two sizes of rods in wells over 4000 feet in depth, and rod strings composed of three sizes of rods in wells over 6500 feet in depth. The design of tapered rod strings is not standardized, and three distinct theoretical approaches to the problem are in current use. One of these methods proportions the rod string so the zone of maximum stress will occur in the top of upper size rods. With a rod string designed along this theory all breaks will occur in the top section of the rod string and fishing and repair time will be kept at a minimum.

Another method is based on the theory of subjecting the lower rods to the maximum allowable stress, and making the remainder of the rod string of the next size larger rods. In a three-size combination rod string, the lower-and middle-size rods are stressed to the maximum allowable working stress, and the remainder of the rod string is made up of the next size rods. This method produces the lightest possible polished rod load. The third method is based on the theory of equal stress at the top of each size sucker rod, and the stress in each size sucker rod is kept at a minimum. This method produces maximum rod life and should be the most economical. The formulas for designing taper rod strings in accordance with the theory of equal stress are shown below, and the percentage constants for common pump and rod sizes are shown in Tables 2 and 3.

Table 2
Percentage Constants for Two Combination Tapered Rod Strings

Plunger Diameter	5/8"—3/4" % of 5/8"	3/4"—7/8" % of 3/4"	7/8"—1" % of 7/8"
1 1/16	68.3	73.5	77.8
1 1/4	65.3	71.6	76.6
1 1/2	60.5	68.5	74.5
1 3/4	54.8	64.9	72.1
2	48.3	60.7	69.3
2 1/4	40.9	56.0	66.2
2 1/2	32.6	50.6	62.7
2 3/4	23.4	44.8	58.8

Table 3
Percetange Constants for Three Combination Tapered Rod Strings

Plunger Diameter	5/8"—3/4"—7/8"		3/4"—7/8"—1"	
	% of 7/8"	% of 3/4"	% of 1"	% of 7/8"
1 1/16	23.3	26.1	19.5	22.3
1 1/4	25.6	28.6	20.9	23.9
1 1/2	29.1	32.6	23.2	26.5
1 3/4	33.3	37.3	25.9	29.6
2	38.1	42.7	28.9	33.1
2 1/4	.....	.....	32.4	37.1
2 1/2	.....	.....	36.3	41.6

Rod Combination: 1" - 7/8"

$$L_2 = \left(\frac{27.39 - P^2}{33.74}\right) L$$

Where: L_2 = Length of 7/8" rod string, in feet
L = Total depth to pump, in ft.
P = Plunger diameter, in inches

Rod Combination: 7/8" - 3/4"

$$L_2 = \left(\frac{17.58 - P^2}{22.37}\right) L$$

Where: L_2 = Length of 3/4" rod string, in feet
L = Total depth to pump, in ft.
P = Plunger diameter, in inches

Rod Combination: 3/4" - 5/8"

$$L_2 = \left(\frac{10.92 - P^2}{14.33}\right) L$$

Where: L_2 = Length of 5/8" rod string, in feet
L = Total depth to pump, in ft.
P = Plunger diameter, in inches

Rod Combination: 1" - 7/8" - 3/4"

$$L_1 = \left(\frac{4.80 + P^2}{30.41}\right) L$$

$$L_2 = \left(\frac{4.79 + P^2}{26.56}\right) L$$

Where: L_1 = Lenth of 1" rod string, in feet
L_2 = Length of 7/8" rod string, in feet
L = Total depth to pump, in feet
P = Plunger diameter, in inches

Rod combination: 7/8" x 3/4" x 5/8"

$$L_1 = \left(\frac{3.41 + P^2}{19.46}\right) L$$

$$L_2 = \left(\frac{3.41 + P^2}{17.36}\right) L$$

Where: L_1 = Length of 7/8" rod string, in feet
L_2 = Length of 3/4" rod string, in feet

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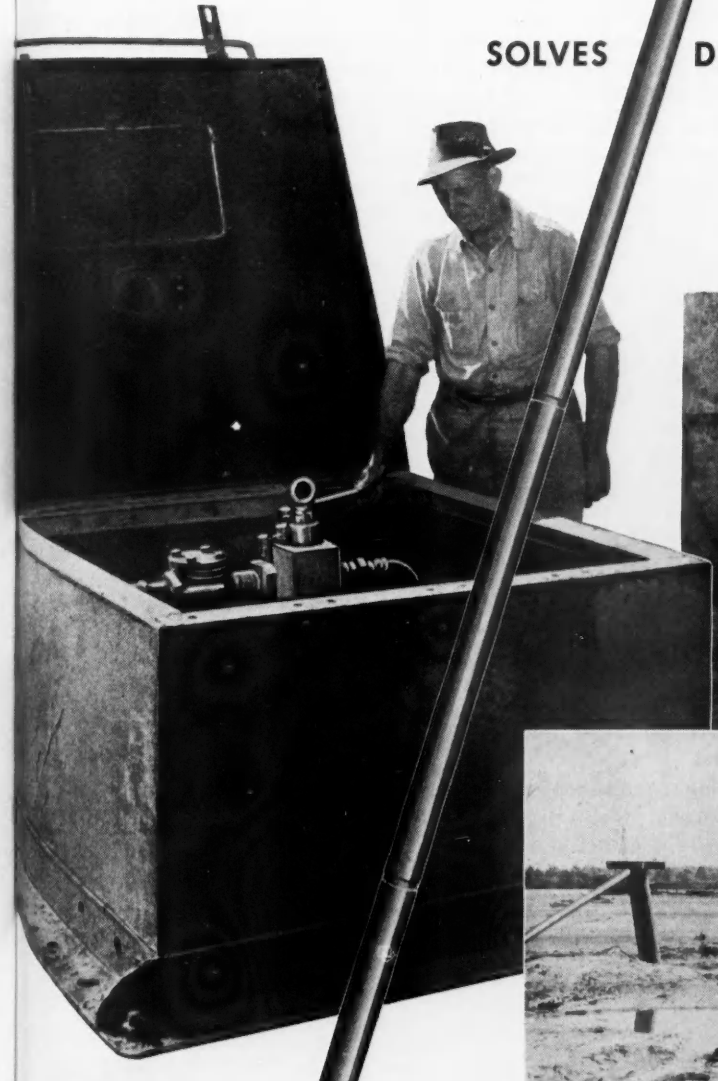
**This figure is based on an industry study by Kobe's General Technical Service Division which is available to you.*



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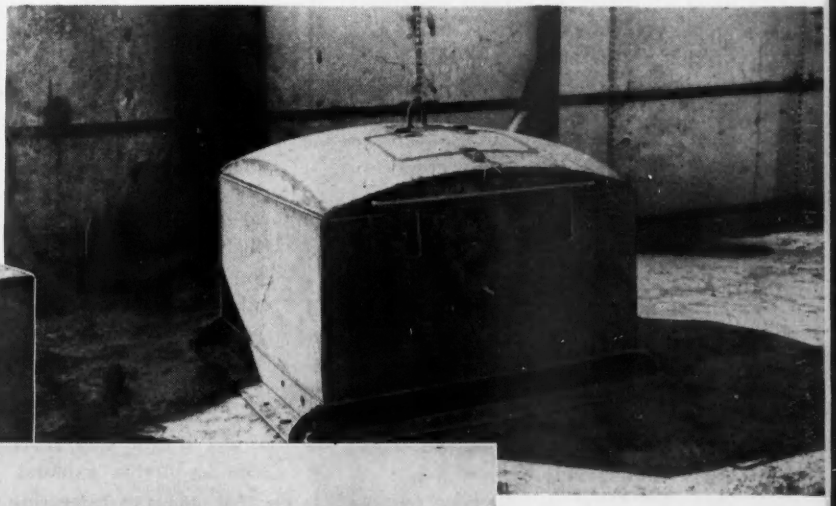
Below are photographs of an unusual *Free Pump* installation in the South Canadian River bed near Sasakwa, Oklahoma. The steel box built around the wellhead is designed to protect the unit against floods, which previously carried away the derrick.



1. Free Pump wellhead is shown as it appears inside the steel box. Pumper has his hand on 4-way valve handle.
2. In this view, with top closed, the unit is secured for high water conditions.
3. Installation, as it appears in river bed.

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L = Total depth to pump, in feet
P = Plunger diameter, in inches

When using tapered rod strings, it must be remembered that they are designed on a purely theoretical basis, and conditions may exist in the well which will unbalance the theoretical considerations. If these conditions exist, they will be evidenced by a concentration of rod failures in one section of the rod string. If these failures are in the lower section of the rod string, the length of the upper section should be increased about 5 percent of the total length of the complete rod string. The problem of calculating the rod and tubing stretch in a tapered rod string can be solved by calculating the stretch for each section of the rod string and adding the results.

Other Factors

If economical operation is to be attained, the engineer's responsibility must not stop with the selection of the equipment, because poor field operation or unforeseen well conditions may subject the equipment to destructive loads. If maximum life is to be obtained from the surface equipment, the unit pumper must be kept properly counterbalanced. In most applications it is impossible to keep the unit pumper in exact counterbalance because well conditions are always in a state of flux. However, if the unit pumper is counterbalanced for the mean of these changing conditions, it is quite unlikely that it will be subjected to destructive loads during its daily cycle of operation.

If a well is pumped only a few hours out of a day, it should be counterbalanced for the conditions existing during the middle of its period of operation. If the degree of counterbalance on a well of this type is checked at the start of its cycle of operation, it is quite likely that it will be found out of balance, but if it is properly counterbalanced, this condition will not exist after a short period of operation.

If a well is pumped with electric power, it can be counterbalanced with an ammeter or an indicating watt meter. The indicating watt meter method is best because it gives true power input. However, both methods will work and in each case the peak values on the up and down strokes should be equal. If the well is pumped with an engine, it can be counterbalanced with an indicating or recording tachometer. When using a tachometer to check the counterbalance, the engine should be under the control of the engine throttle and not the governor. The condition can be attained by closing the hand throttle slightly. When the engine is operating under this condition, its speed on the up and down strokes should be equal.

In the cases of severe out-of-balance, it is not necessary to use these more exact methods to detect improper counterbalance. If the degree of unbalance is severe, the pumper will speed up on one phase of the stroke and slow down on the other. This can be detected by observing the rotation of the cranks. If the pumper is powered with an engine and is out of balance, the engine will exhaust unevenly, with heavy explosions occurring regularly on one phase of the stroke and light explosions on the other phase of the stroke. If the well is powered with an electric motor, the "whine" of the motor will serve the same purpose as engine exhaust.

All adverse operating conditions are not as obvious as improper counterbalance, but can be equally destructive to both surface and sub-surface equipment. The conditions in this class are usually caused by subsurface conditions and in some cases can be detected only with a polished rod dynamometer. Some of these conditions such as pounding fluid, gas lock, and excess pumping speed can be detected by surface observation. However, this method is always subject to question, and the most reliable method of detection is the dynamometer.

Some typical trouble well dynamometer cards are shown in Figures 13, 14, 15, 16, and 17. Out of all the conditions shown in these dynamometer cards, the two most destructive are "fluid pound" and "the clamp leaving the cross bar." The latter subjects the surface equipment to very severe impact loads, and has been responsible for numerous wire line, beam, and pitman failures. This condition can be caused by excessive speed, paraffin formation in tubing, excessive pump friction, or extremely viscious fluid. In addition to damaging the equipment, all of these conditions cause losses in efficiency and thus further add to the production costs.

In addition to detecting adverse operating conditions in a well, dynamometer studies can be used to improve operating conditions. It has been shown by Slonneger[1] and his findings were checked and expanded by the writer and S. E. Corry,[2] that the dynamometer card shape and possibly the maximum well load is a function of pumping speed and well depth. Due to the nature of the forces responsible for the shape of the dynamometer card,[3,4] the problem does not lend itself to exact mathematical analysis, and final adjustments can only be obtained experimentally. In some cases, it is possible to obtain material reductions in well load by adjusting the pumping speed a few strokes per minute up or down. This gain can only be obtained by dynamometer studies as this is the only means available for evaluating the results of changes.

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[1] "Vibration Problems in Oil Wells," by J. C. Slonneger. API Drilling & Production practice. 1937.

[2] "Comparison of Prime Movers for Pumping Wells," by J. H. Fields, presented to National Conference on Petroleum. Mechanical Engineering of ASME, Houston, Oct. 5-8, 1947.

[3] "Effects of Rod Vibration on Dynamometer Cards," by Kenneth N. Mills and S. E. Corry. *The Oil Weekly*, July 24, 1940.

[4] "Correlation of Polished Rod Acceleration and Well Load," by Kenneth N. Mills. *The Petroleum Engineer*, January, 1944.

About the Author: Kenneth N. Mills is assistant chief engineer, Mechanical division, Emsco Derrick and Equipment Company, Houston plant. A graduate of Rice Institute, Houston, Mills was formerly chief engineer for American Manufacturing Company of Texas, chief engineer of the Manufacturing division of Bethlehem Supply Company, Tulsa, and was later connected with Hughes Tool Company, Houston. He joined Emsco February 1, 1946. He has devoted much time to analytical studies of problems encountered in oil well pumping and also has made numerous photoelastic stress studies of stress distribution in welded structures.

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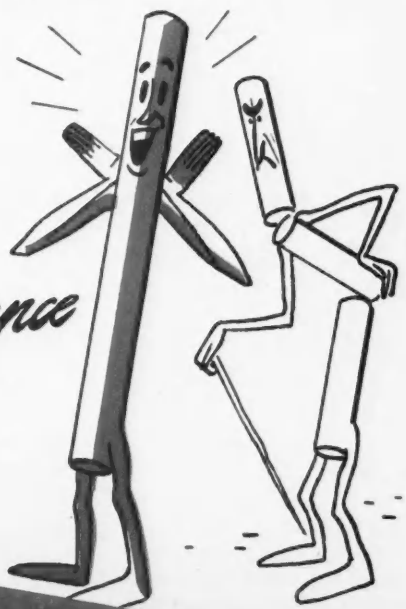

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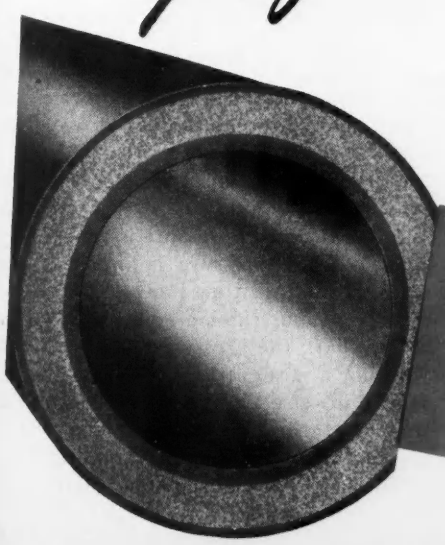
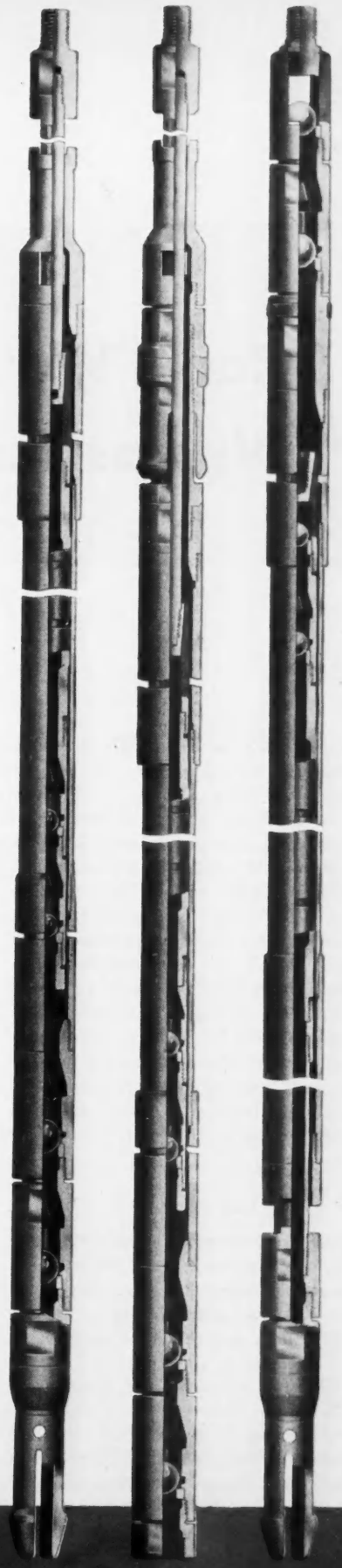


View of the IMPROVED INSERT pump barrel, showing how super-hard wearing surfaces for long life are combined with ductile core for high tensile strength.



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Rapid Water Bypass Test

FIGURE 1. Testing intake characteristics of a water-input well with portable orifice meter.
Photo Courtesy U. S. Bureau of Mines

By ANTHONY GIBBON
Staff Writer

A NEW technique designed to quickly check bypassing of injection water in sands subject to water flooding has been successfully applied in Pennsylvania and the Mid-Continent. The technique is described here and certain conditions which result in bypassing are discussed.

AMONG the most difficult problems encountered by operators engaged in secondary-recovery of oil through water-flooding methods is that presented by the bypassing of water injected into the oil reservoir. When bypassing occurs little or no oil is recoverable and in many instances the operator is forced to abandon the project since he can no longer operate the flood economically. This problem has prompted considerable research on the part of government agencies, notably the U. S. Bureau of Mines, as well as by operating oil companies, educational institutions equipped with research facilities and associations of water-flood operators in various sections of the country.

Fast Method

A technique designed to quickly check bypassing of injection water in sands under water flooding has been developed in the East and successfully applied to water-flooding projects in Pennsylvania fields. Recently it was tried out for the first time in Oklahoma and Kansas and the technique and its results described before a group of water flood operators at Independence, Kansas. The device (Figure 1) is easily assembled and permits a rapid method for testing the behavior of individual water-input wells as a means of determining the intake capacity and the pressure limit at which bypassing will occur.

As a general observation bypassing of injection water can be classified into three types:

1. Bypassing through oil-depleted portions of the sand section. This may be remedied by selective plugging.

2. Bypassing through low oil-high water saturated sand sections. At the present time no suitable remedial measures are known which would overcome or correct this type of bypassing and it is necessary to produce large quantities of water with the oil during the operation of the flood.

3. Bypassing through fracture planes, both vertical and horizontal, resulting from the effects of shooting the producing formation or because of natural causes resulting from geological factors in the particular field.

The technique can be applied successfully where bypassing is occurring as a result of fracture planes in the producing formation and its successful application also may serve to predict the need for remedial measures and the probable effects which may be expected after such measures are adopted.

Pressure Range Covered

In making the test with the device the water input rate may be tested over the entire pressure range for a reservoir that has attained a fill-up of the pore space provided the input well is first shut in until the wellhead pressure is practically stable. If the pressure is increased in steps, at uniform time intervals, and the resulting input rates are recorded on a meter chart, the pressure and input rate will plot a straight line on graph paper. If the increase in pressure is continued, the curve will go through a point of inflection, above which the input rate increases sharply with further change in

pressure. The slope of the straight line, from zero rate to the point of inflection, is a measure of the intake capacity of the well. The point of inflection is the critical pressure or the pressure limit above which bypassing will occur (Figure 2).

Determination of the critical pressure is particularly important because many operators prefer to use the highest rates and pressures permissible so as to shorten the pay-out period of the flood.

Another type of bypassing is that which occurs above the critical pressure, as shown on pressure rate curves, and is a result of formation parting or ruptures that yield to the applied pressure This type of bypassing is avoidable through knowledge of the critical pressure and proper pressure control. Various investigators have suggested that this type of break-through may be due to one or more of the following reasons:

1. Compaction of shale partings through or adjacent to the sand body.

2. Elongation of shot cracks, both horizontal and vertical.

3. Unbalanced pressure distribution in the reservoir.

4. Lifting of the overburden.

Assuming that more than one of the above reasons is sound, it becomes apparent that some wells may exhibit more than one critical pressure on the pressure-rate curve.

Critical pressure, divided by the depth of the formation, frequently provides a factor that agrees closely with the theoretical weight of the overburden, or approximately one pound per square inch per foot of depth. However, it cannot invariably be construed that the overburden actually lifts if such a critical pressure is exceeded.

Experiments using the rapid water bypass test technique conducted in old floods in Kansas and Oklahoma in which the reservoir voids had become filled with injected water showed that:

1. The time necessary to wait after shutting in of input well until a stable pressure was realized was between a few minutes and a few hours, depending upon the sand properties. After the "pressure drop off" curve levels off the pressure change becomes so small that stabilized pressure was assumed.

2. Negative pressures (vacuum at the wellhead) were not measurable with the instruments used in the test.

3. A straight line pressure-rate of flow curve can be obtained only by increasing pressure at regular intervals of time. Five minutes between pressure changes were normally used although ten- and 15-minute intervals were tried with similar curves resulting. Hours to days between pressure changes would give similar curves.

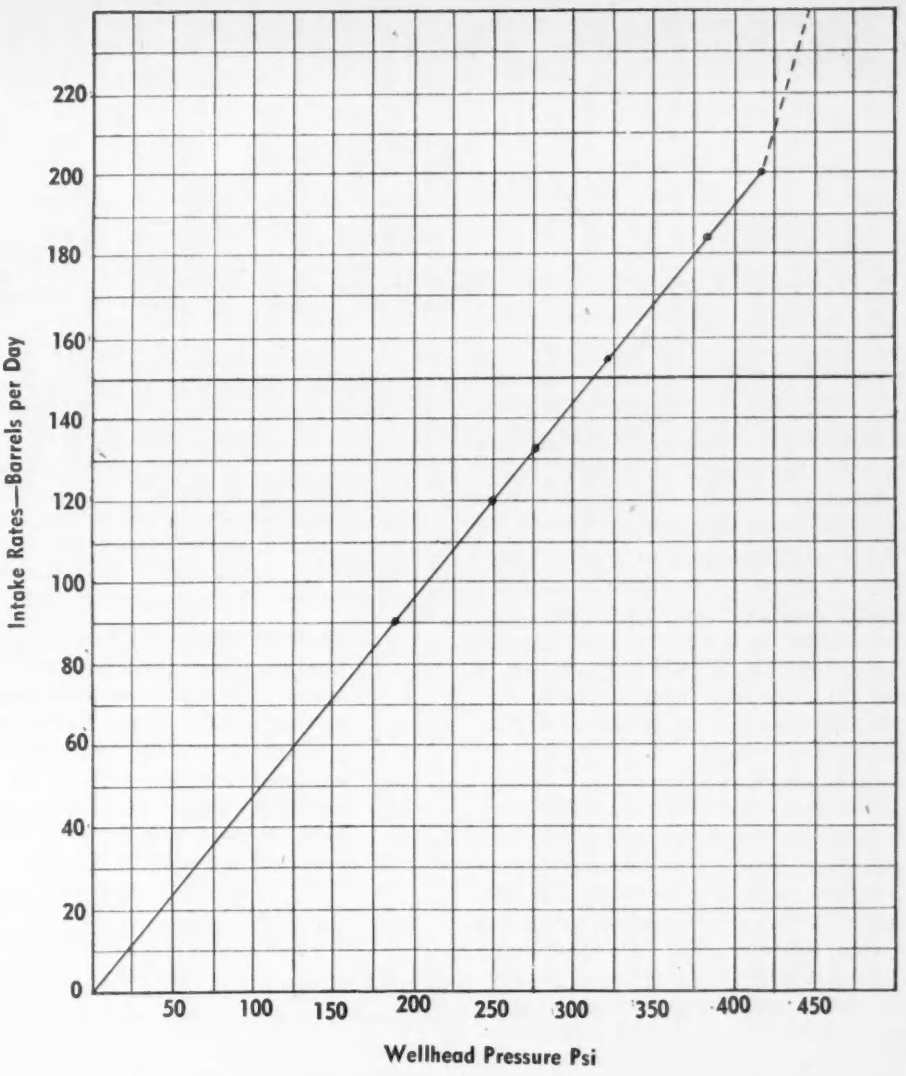

FIGURE 2. Typical curve showing bypassing of injection water at 390 pounds pressure per square inch on water intake rate of 200 barrels per day.

Application of the technique apparently provides a rapid means of measuring intake capacity and critical input pressure. Periodic measurements of intake capacity also indicate the behavior of input wells over a period of time and the information may be used to predict need for remedial measures.

Remedial Measures

Where bypassing is apparent, the need for adopting remedial measures wherever possible is the next important consideration and considerable research has already been undertaken in an endeavor to develop suitable plugging material which can be selectively applied in order to overcome or mitigate the condition. Investigation has disclosed that if water bypasses through washout zones or through permanent fractures, it usually does so at all pressures and may be prevented by selective application of special plugging materials to the sand. However, it is not feasible to prevent bypassing by selective application of plugging material if bypassing is occurring only at pressures above the critical pressure. Rather it will be necessary to reduce the operating pressure to a point below the critical pressure.

In water floods where the reason for bypassing is variations in relative permeability to water, resin emulsions have been applied with great success, especially in the Bradford pool of Pennsylvania as indicated by close check of the intake rates as well as water-oil ratios of the produced liquids. In field experiments it has been observed that the success of selective plugging with emulsions depends greatly on the particle size of the dispersed solids. So far, the application of these emulsions in the Mid-Continent area has not proved very successful but it is felt that they can be used with success by properly adjusting their physical properties.

SELECTIVE PLUGGING WITH SMOKE

By R. F. NIELSEN
Division of Petroleum & Natural Gas Engineering
The Pennsylvania State College

VARIOUS METHODS of smoke generation are reviewed here and laboratory and field tests involving them described. While some methods gave fair selective plugging in the laboratory, those involving passing smoke down the tubing have so far not proved successful in the field. A method in which smoke is formed at the sand face gave reduction of gas intake rate, but lacks permanence. The paper, one at the Eleventh Annual Secondary Recovery Conference, Pennsylvania State College, should eliminate much useless experimentation in the search for an effective sand-plugging agent.

THE possibility that smokes or "aerosols" might serve as selective plugging agents in air-gas drive just as "aquasols" have served in water flooding was suggested by Yuster and Calhoun[1] in a paper dealing with the general status of selective plugging. A report of experimental work on the use of smokes for selective plugging was given at the Ninth Annual Secondary Recovery Conference.[2]

There are several general methods of preparing smokes or suspensions of solids in gases: (1) mechanical dispersion of a fine powder in an air or gas stream; (2) quenching of the vapors of a volatile solid by a cold gas stream; (3) chemical reactions, such as the burning of a material or the combination of two gases like ammonia and hydrogen chloride; (4) atomization of a solution of a solid in a volatile solvent, supplying sufficient air or gas to vaporize the solvent.

Plugging experiments involving the first two methods were described in the report referred to above. In the use of Method 1, the smoke or dust was passed slowly upward to allow settling of the larger particles. The resulting smoke, however, gave little or no plugging in laboratory experiments.

Various modifications of Method 2, the quenching of a vapor, were found to give good selective plugging in the laboratory. The data have been presented previously. The difficulties arose in field trials when it was found impossible to supply enough cooling of the vapors to obtain a large quantity of dry and stable smoke. The smoke pot described earlier was modified to provide thermally insulating rings between the top and bottom sections and to allow throttling of carbon dioxide directly from a cylinder into the top section. Even with these modifications the resulting smoke was either not dry or too thin to be effective.

Among the chemical smokes tried were military smoke grenades, furnished from the Army surplus. These were set off in an iron pot connected in the injection air or gas line. Both the white smokes, consisting mainly of zinc dust and hexachloroethane, and the colored smokes, consisting, except for the dyestuff, mainly of inorganic materials, were tried. The white grenades did not behave normally under confinement, and after they had been burning smoothly for a short while, a sudden reaction took place with a surge of pressure, resulting in large quantities of partially decomposed hexachloroethane being deposited on the pipes. The colored grenades behaved normally, but there was no appreciable plugging action, although the cores were covered with a colored powder. There also was considerable deposition of the colored powder on the inside of the pipe.

TABLE 1
Effect of Ammonium Chloride Smoke on Gas Intake Rates

DATE	Pressure psi Gauge	Injection Rate CFD	Conditions
Sept. 18, 1946	19	7680	Before NH_4Cl Smoke
Dec. 11, 1946	15	6000	Before NH_4Cl Smoke
Dec. 11, 1946	15	2950	
Dec. 12, 1946	15	4100	⅔ of Cylinders Used
Dec. 12, 1946	15	2800	Next day before continuing
Dec. 19, 1946	14.5	2640	All Chemicals In
Dec. 26, 1946	17	3120	
Dec. 26, 1946	15	2160	
Jan. 2, 1947	13.5	1920	
Jan. 2, 1947	15	2640	
July 8, 1947	15	6000	

The chemical smoke which has shown the most promise so far is ammonium chloride smoke. This has been made in three different ways. The first, which is not strictly a chemical method, consisted in quenching the vapors from the hot salt in a stream of cold air or gas. In the second method a stream of dry gas containing ammonia was continuously mixed with one containing hydrogen chloride. In the third method alternate slugs of dry air or gas containing ammonia and hydrogen chloride were run into the tubing, with a slug of dry air or gas between slugs of the reacting gases. With this last procedure there should be very little smoke formed in the pipe, but it would be formed opposite the sand face. In the laboratory the results by the three methods were about the same, fairly good plugging and selectivity being obtained.[2]

Because of the tendency of this smoke to deposit on pipes, only the third method was tried in the field. Figure 1 shows the hookup used. Amounts of the various gases were controlled manually by needle valves with the aid of small orifice meters. About a minute elapsed between each change of mixture. To keep corrosion at a minimum, the gas was passed over amylamine, and the ammonia was always run in slightly in chemical excess over the hydrogen chloride. Since hydrogen chloride forms a

mist with gas containing water vapor, the latter was removed by passing the lease gas through a piece of four-inch pipe containing anhydrous calcium chloride.

Table 1 shows the results of the ammonium chloride injection, as determined by individual orifice meter readings. These show a definite reduction in intake rates. Figure 2 is a copy of the injectivity tests made by the Bureau of Mines Field Office in Franklin, Penn. These also show a definite reduction in intake rate, but it is seen that the plugging action was not permanent, that is, 21 days after the treatment there is some gain in injectivity and six months later the well is taking air as fast as before treatment. The ammonium chloride may have dissolved or may have been swept away mechanically. From the solubility and vapor pressure lowering of ammonium chloride in water, it would pick up moisture from the injected gas if the gas were more than 70 percent saturated at the pressure and temperature of the sand face. Since in this particular well the gas was throttled down a great deal from line pressure, it seems unlikely that the salt would pick up moisture from the gas except on a very warm day. The preparation of ammonium chloride smoke by the above method had the disadvantages of being somewhat involved and of using corrosive chemicals.

The use of alternate slugs of reacting gases (separated by slugs of dry air) was also tried in the laboratory with certain chlorides which form a smoke by reaction of the vapors with moist air. The compounds tried were antimony pentachloride, tin tetrachloride, and titanium tetrachloride. A dry air stream passed over one of these liquids was alternated with an air stream passed over aqueous ammonia of such concentration as would give ammonia and water vapor in the proper ratio for chemical reaction. No appreciable plugging action was obtained with any of these three compounds, although the smoke appeared quite dense and a considerable amount of powder was deposited on the cores.

Fourth Method

The fourth method, atomization of a solution of a solid in a volatile solvent, was tried both in the laboratory and in the field. The hookup is shown in Figure 3. The nozzle was of a pneumatic type, requiring a pressure differential of about 20 to 30 pounds per square inch for operation. In the laboratory the spray was directed into a 55-gallon drum, instead of the larger tank shown in the figure. The solutions used were paraffin in naphtha, paraffin in carbon tetrachloride, paraffin in liquid butane, and "Vinsol" in acetone. "Vinsol," a resin derivative, was tried at the suggestion of the manufacturer. The solutions generally contained from 10 to 20 percent of the solid by weight, depending on solubility. It is necessary, of course, that the

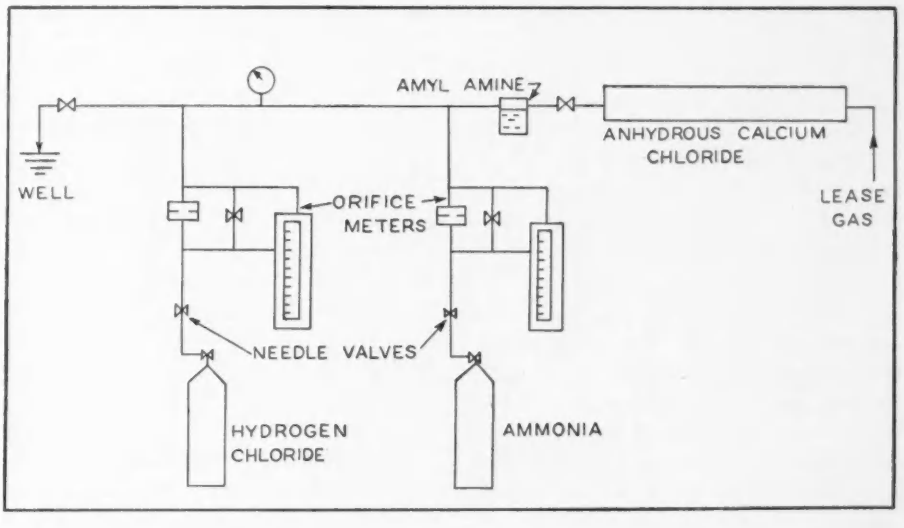

FIGURE 1 (Above). Arrangement for alternate injection of ammonia and hydrogen chloride into well.

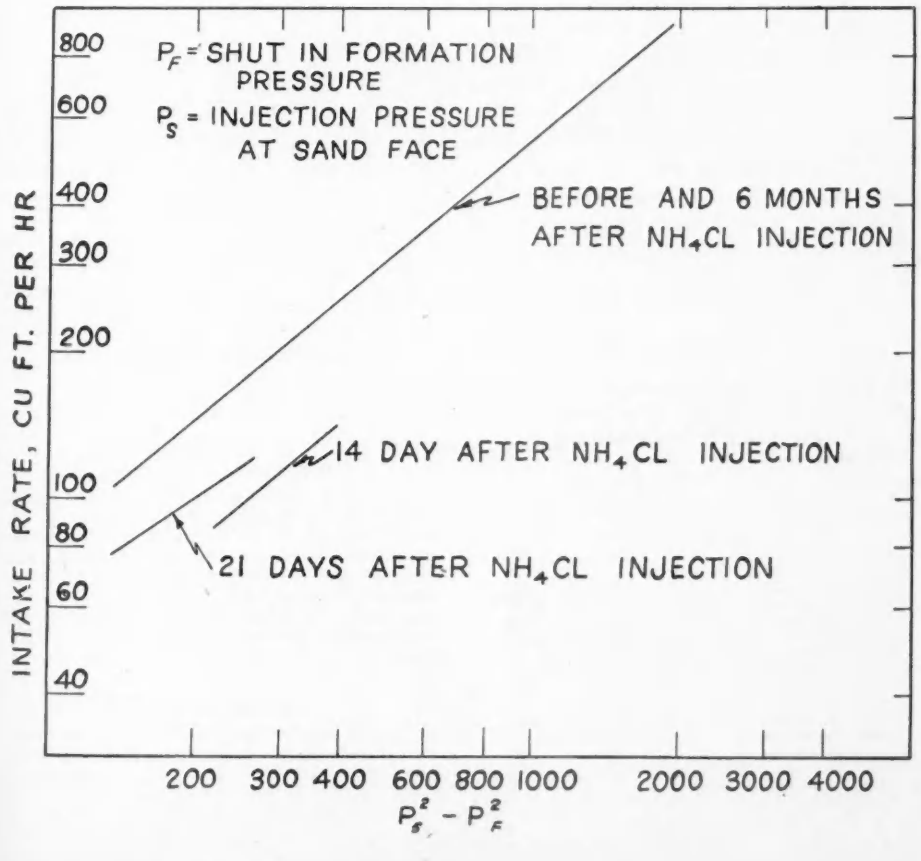

FIGURE 2 (Left). Effect of NH_4CL smoke on injectivity of well.

Courtesy U. S. Bureau of Mines

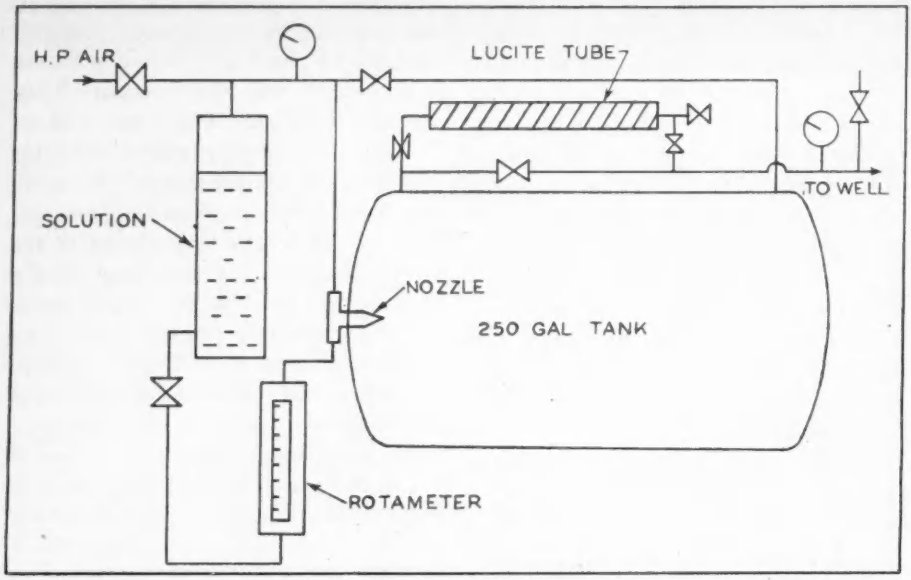

FIGURE 3. Arrangement for injection of smoke made by atomizing a solution of a solid in a volatile solvent.

air or gas stream vaporize all the solvent in order that the smoke may be dry. To do this more air usually was required than that supplied to the nozzle for atomization, hence the additional air line to the drum. The amounts of air theoretically required at various pressures and temperatures were calculated from thermal and vapor pressure data, and at least a 50 percent margin over the calculated air/liquid ratio was allowed. The purpose of the small "Rotameter" was to measure liquid rates, air rates being determined in the laboratory by a displacement meter and in the field by the known injectivity of the well.

Results of Experiments

A core holder large enough for six or eight radial cores of varying permeabilities was used in the laboratory experiments. Since some of the solutions were inflammable, nitrogen was used instead of air. Back pressure was provided by having the outlet under about five feet of water. Fairly good selective plugging was obtained with all solutions in laboratory tests. The results are shown in Table 2. The smoke from the butane solution was not as fine as that from the other solutions, and showed a little more tendency to stick to pipes. This may have been because the pressure in the drum was below the vapor pressure of butane, causing too rapid evaporation.

In the field tests attempts were made at first to employ the lease gas, but the high solubility of hydrocarbon gases in the solvents interfered both with proper atomization and with evaporation. Nitrogen was subsequently used and finally air. The latter is, of course, hazardous with inflammable liquids and proper precautions must be taken.

The well was the same as had been treated previously with ammonium chloride. It was taking about 6000 cubic feet per day at 19 pounds gauge. It is estimated that about five pounds of paraffin and five pounds of Vinsol were sent down the well. About two months elapsed between the two treatments. Neither had any measurable effect on the gas intake rate. This result was somewhat disappointing, both in view of the laboratory data and inasmuch as the smoke, especially the Vinsol smoke, seemed to be perfectly dry and stable and of very small particle size. Since the question naturally arose as to whether the smoke actually got down the well, 850 feet of one-inch pipe was strung out on the ground. The smoke was sent through it at about the same rate as it was sent down the well. As near as the eye could tell, the quantity of smoke was about the same at the end of the string of pipe as when bled off at the source. Also practically no deposition could be observed on the pipe although there was some at fittings and valves.

TABLE 2

Plugging of Laboratory Cores by Smokes Made by Atomization of a Solution of a Solid in a Volatile Solvent

SOLUTION	Perm. Before Plugging md.	Percent Reduction
Paraffin in Naphtha	260	41
Paraffin in Naphtha	170	72
Paraffin in Naphtha	65	62
Paraffin in Naphtha	15	5
Paraffin in Butane	310	44
Paraffin in Butane	260	71
Paraffin in Butane	220	41
Paraffin in Butane	160	66
Paraffin in Butane	105	28
Paraffin in Butane	15	9
"Vinsol" in Acetone	200	75
"Vinsol" in Acetone	145	63
"Vinsol" in Acetone	100	40
"Vinsol" in Acetone	55	65
"Vinsol" in Acetone	45	50
"Vinsol" in Acetone	15	8

Difference in Results

The results of these field tests cannot readily be accounted for if, as the test with the string of pipe indicates, the smoke reached the sand face. If there had been some small lowering of the intake rate, an insufficient quantity of material would be blamed. It is known that the average smoke particle size increases with time, due to agglomeration. This may be one explanation for the difference between laboratory and field results when smoke is sent down the tubing. A possible remedy for this would be to inject at a greatly increased pressure, so as to cut down the time of travel. The glistening appearance of the laboratory cores after plugging and the extremely small amount of material required for plugging indicate that the particle size was very small in the laboratory experiments. There is of course always the possibility that the particular well treated was not a fair test of the method. Perhaps a test on another well and with a higher injection rate would prove enlightening.

Summary

1. The various methods of smoke generation were reviewed and the laboratory and field tests involving these methods were described.

2. While a number of methods gave fair selective plugging in the laboratory, those necessitating passing the smoke down the tubing have not been successful in the field so far.

3. A method in which the smoke was formed at the sand face by alternate injection of ammonia and hydrogen chloride gave a reduction of about 50 percent in gas intake rate, but the plug was not permanent.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge the advice and assistance of Dr. S. T. Yuster, Mr. K. W. Smith, and Mr. D. E. Menzie of the Pennsylvania State College, and of Mr. R. B. Bossler and the personnel of the Brundred Oil Corporation who collaborated in the field experiments. He also wishes to acknowledge the support of the Pennsylvania Grade Crude Oil Association toward this work.

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Pressure Maintenance and Cycling Plants . . . INCREASE RECOVERY

FAVORABLE RESULTS in California show importance of pressure maintenance projects and cycling plants as means for increasing recovery from oil and condensate fields. These facilities prolong flowing life, cut production costs, and increase the total amount of fuel that will be produced in the long run.

INVOLVING the injection of gas into natural reservoirs containing reserves of oil or condensate or both, "pressure maintenance" is the name given to an oil-producing program under which the natural pressure of the reservoir is kept as high as practicable by injecting gas. Pressure may not be kept constant, but the rate of decline is retarded. An accompanying drawing shows a typical pressure maintenance project.

The practice has as its primary objective an increase in the ultimate yield of oil and condensate. In addition the practice effects a decrease in oil production costs. These two objects are consistent, because lower costs reduce the minimum profitable production rate, and thereby postpone the abandonment of wells.

The Oil and Gas Sand

The typical petroleum reservoir in California consists of an aggregate of minute pore spaces between grains of a sandy formation. The productive formation may be 100 feet or more in thickness or, more likely, will be a series of sandy layers interspaced with impermeable shales.

As an example of the quantity in place, as oil occurs in oil sands, assume that one cubic foot of sand contains about a gallon of oil. The yield, however, from this natural deposit would be much less.

Some reasons for the fact that yield is less than the original content of the sand are as follows:

1. Oil sticks to the formation.
2. Gas bubbles issuing from the oil upon reduction of pressure clog up the minute pasageways between sand grains and obstruct the flow of oil.
3. Migration of oil is not uniform, leaving some portions of the oil sand undrained.
4. Encroaching edgewater follows a devious course, surrounding bodies of oil saturated sand, and entrapping the oil therein.
5. Pressure, which provides the force to cause oil to flow, is exhausted before the oil is obtained.
6. The well rate declines to an unprofitable yield, and the well is abandoned.
7. Physical defects in and around the wells reduce rates of production.
8. The oil gives up gas, and is cooled at the surface. Each of these changes causes a shrinkage.

The result is that estimated recovery of oil from California sands varies from a low of 15 percent to a possible 40 percent of oil in place, with higher recoveries dependent upon exceptional circumstances.

Now, suppose we have an oil reservoir of some size, say, a square mile or 640 acres, with an oil zone containing an aggregate of 200 feet of oil sand at one gallon per cubic foot in place. The oil contains in solution in this type case, a typical 600 cubic feet of gas per barrel, but there is no free gas cap. These figures, converted to larger dimensions are: 1037 barrels of oil per acre-foot and 500 Mcf of gas per acre-foot, or for all 640 acres at 200 foot thickness, a total of 132,736,000 barrels of oil, and 64 million Mcf of gas. These quantities are in terms usually quoted by petroleum engineers. The oil volume is in terms of liquid petroleum in place. The gas volume is in terms of standard conditions at the surface, notwithstanding that all gas is in solution in the oil. (For reference: 1037 barels of oil per acre-foot x 600 cubic feet of gas per barrel of tank oil, all divided by 1.25 barrels of oil in place per barrel of tank oil. This gives 497.76 or approximately 500 Mcf. of gas per acre-foot in place.)

Contrary to the situation for oil, gas moves through sand with ease and therefore the recovery factor is much higher. A yield of 85 percent of gas in place would be in order.

Many details would have to be correlated before one could arrive at an estimated recovery factor for oil in a particular case, but for illustrative purposes suppose that this reservoir is partially developed. Production by the usual method indicates an ultimate yield of 25 percent of the oil and 85 percent of the gas, all in the course of some 30 to 40 years. In terms of products, this yield is 33 million barrels of oil and 54,400,000 Mcf. gas.

Note that the gas oil ratio of yield is a little less than 2 Mcf. per barrel of oil.

Reasons for Pressure Maintenance

Engineers, viewing this situation and fully informed as to difficulties of extracting oil from sand, turn to pressure maintenance by gas injection, for specific reasons which have been well stated, as given below.

Gas injection offers advantages as follows:

1. Maintains viscosity of oil. The viscosity of the oil in a reservoir is directly affected by the amount of gas dissolved in it. When oil is saturated with gas, which is possible at high pressure, its viscosity is materially lower, giving the

From testimony before California Public Utilities Commission at San Francisco, as representative of Natural Gas Producers' Association of California and Oil Producers' Agency of California.

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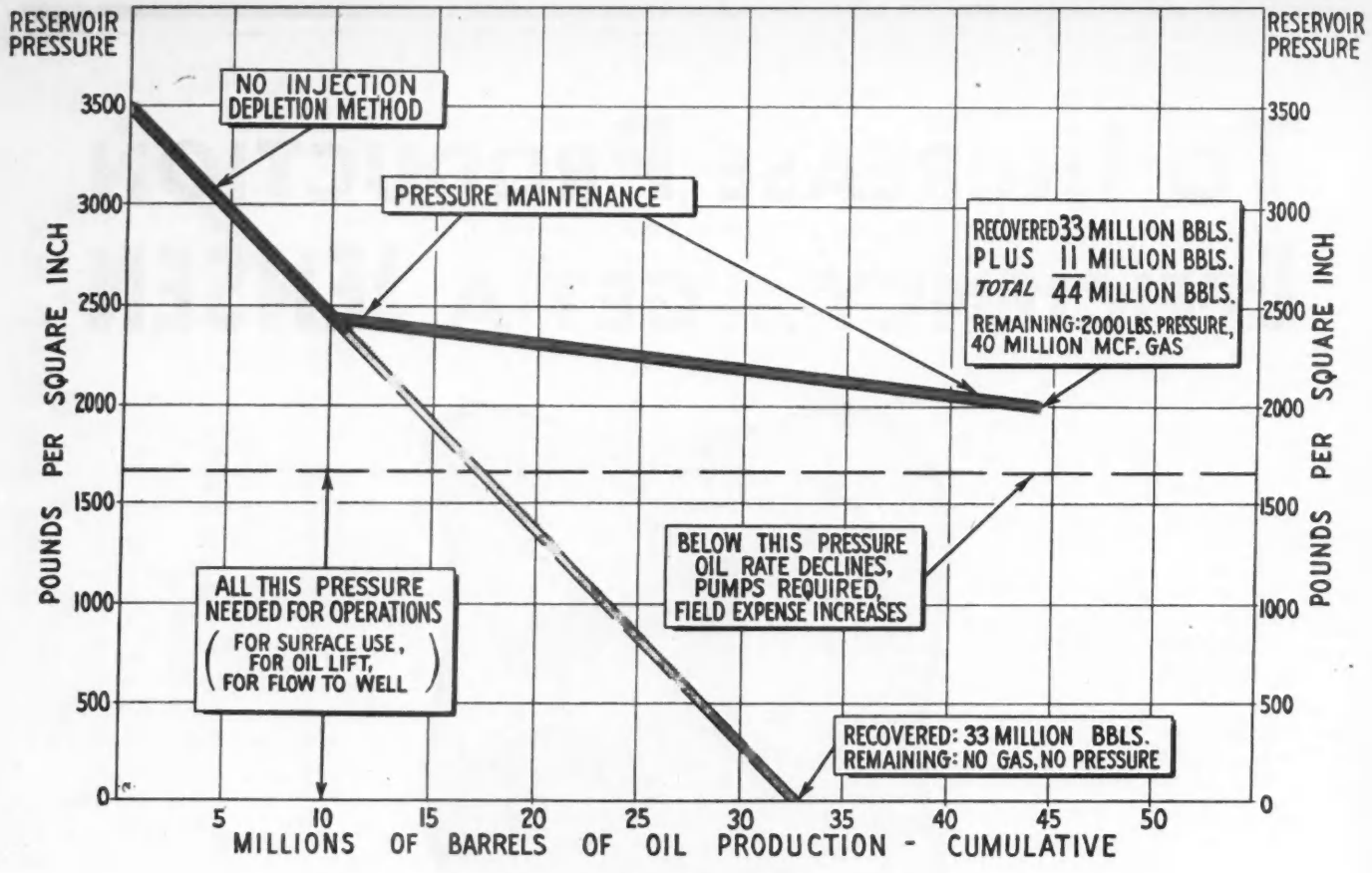
RESERVOIR PRESSURE
POUNDS PER SQUARE INCH
3500
3000
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2000
1500
1000
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0
NO INJECTION DEPLETION METHOD
PRESSURE MAINTENANCE
RECOVERED 33 MILLION BBLS.
PLUS 11 MILLION BBLS.
TOTAL 44 MILLION BBLS.
REMAINING: 2000 LBS. PRESSURE, 40 MILLION MCF. GAS
ALL THIS PRESSURE NEEDED FOR OPERATIONS
(FOR SURFACE USE, FOR OIL LIFT, FOR FLOW TO WELL)
BELOW THIS PRESSURE OIL RATE DECLINES, PUMPS REQUIRED, FIELD EXPENSE INCREASES
RECOVERED: 33 MILLION BBLS.
REMAINING: NO GAS, NO PRESSURE
5 10 15 20 25 30 35 40 45 50
MILLIONS OF BARRELS OF OIL PRODUCTION - CUMULATIVE

Pressure vs. production. Typical California case.

oil greater mobility in flowing through the sand to the well bore. For example, if the pressure in a reservoir containing 30 degrees API gravity tank oil were permitted to drop from 3600 to 1000 pounds per square inch the viscosity of that oil would more than double. Considering that the flow of the oil through the sand is inversely proportional to its absolute viscosity, a lower viscosity is extremely conducive to oil recovery. The maintenance of a gas-cap in the reservoir will tend to prevent the escape of gas initially dissolved in the oil.

2. Maintains surface tension of oil. The reservoir engineers are of the opinion that by keeping the surface tension of the oil low the better will be the producing characteristics of the reservoir. Oil in which the dissolved gas is retained in solution, such as by gas injection, will have a lower surface tension than if the pressure is allowed to decline and the gas permitted to come out of solution.

3. Serves as expulsive force. As the oil approaches and enters the bore of the producing well, where the pressure is necessarily reduced, some gas coming out of solution will remain in the oil as occluded bubbles, which lightens the producing column and assists in lifting the oil to the surface.

4. Prevents oil entering gas sands. By sustaining a gas pressure above the oil, the oil is prevented from flowing up to the crest of the structure and into the parts originally containing gas. A movement of oil into the overlying gas sands results in a loss of oil in the sands which were initially free of oil.

5. Controls edgewater encroachment. By controlling pressure in the reservoir with gas the encroachment of edgewater may be retarded and controlled. An uncontrolled water drive may sometimes result in an uneven or spotty advance of water, which may entrap portions of the undrained oil sand. The entrapped oil, if recoverable, may be obtained only with difficulty and at added cost.

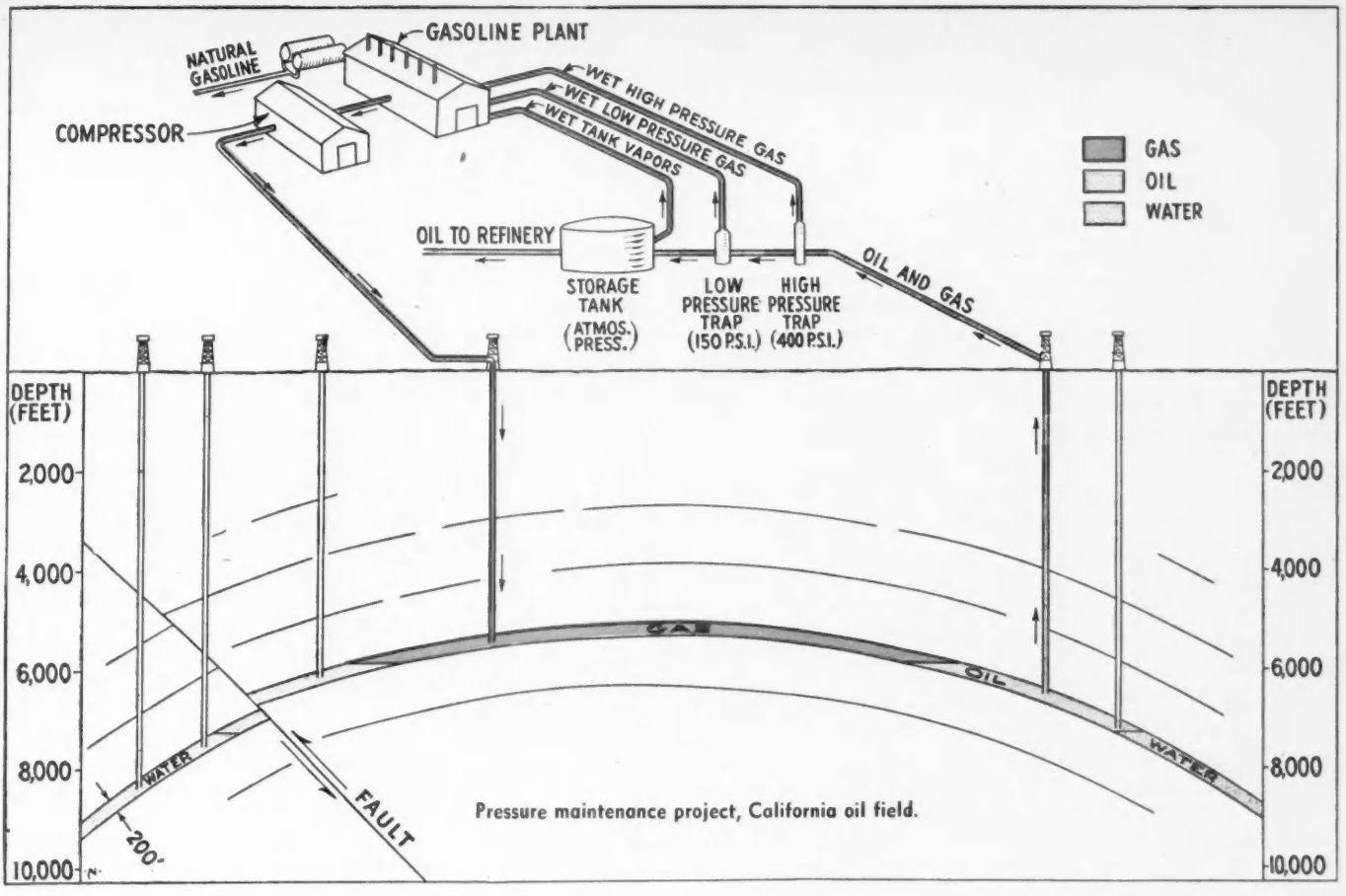
6. Lower production costs. In an ideally suitable reservoir practically all of the recoverable oil may be produced by natural flow without requiring the use of artificial lifting devices, such as sucker rods, pumps, hydraulic pumping units, and gas lift operations, all of which, by comparison with natural flow, are considerably more costly per barrel of oil recovered. The injection of gas is an effective way of sustaining this natural flow.

7. Prevents retrograde condensation. Under certain pressure and temperature conditions in a reservoir a portion and in some cases all of the hydrocarbons may be in a gaseous phase. If the pressure in these reservoirs is permitted to decline certain of these hydrocarbons pass from the gaseous phase to the liquid phase, which physical phenomenon is known as retrograde condensation. From the producers' viewpoint this transition is most costly, inasmuch as in passing from a gas to a liquid form the hydrocarbons not only lose their high mobility, but as a liquid a certain portion becomes irrecoverable. It is, therefore, quite apparent that, if the maximum possible recovery of the hydrocarbons in a gas-condensate pool is to be attained, the pressure in the reservoir must be maintained.

The above reasons were taken from the proceedings of the Pacific Coast Gas Association, Vol. 37, 1946.

When these advantages are appraised in terms of yield from the oil sands, the estimated increase is from 50 to 100 percent more than by the natural depletion method. In addition, the estimated overall cost of production and field operating is reduced to such extent that a pressure maintenance program may be finally approved for this reason alone.

In the present example, suppose that engineers are very cautious and go on record for an increase in ultimate recovery of only 1/3; that is 33-1/3 percent more than 33 million barrels, or 11 million barrels. This increase is to



Pressure maintenance project, California oil field.

be accomplished by building and operating a pressure maintenance plant for at least 20 years.

This pressure maintenance plant is to cost $700,000, and well repairs and injection well expense, $300,000, a total outlay of $1 million. As for building and operating the plant, the cost is more than covered by eliminating installation of pumping equipment and other expenses for the 20 year period.

Natural gas used for fuel in internal combustion engines runs about 12 cubic feet per horse power per hour or 28.8 Mcf per day per 100 hp. In the case now being analyzed, the assumption is that a 4000 hp plant is required. Gas consumption at full load would be 1152 Mcf daily.

However, this fuel consumption cannot be considered as a net loss of the gas by virtue of the construction of a pressure maintenance plant. If no pressure maintenance program were adopted, the wells in the field in question would, within a relatively short time, require the installation of pumping facilities, which would ordinarily use gas as fuel. Assuming a spacing of one well to 10 acres, 64 wells would be in operation and would require about 400 Mcf daily for this purpose. In addition, the wells, as they went on the pump, would be producing at low surface pressure and would require field compressors to increase the pressure of the gas to a sufficient extent to run it through the gasoline plant and into the utility pipe line. An additional 200 Mcf daily would be required for this purpose. Thus about 600 Mcf daily would be required to produce the field, in accordance with ordinary depletion methods, or about one-half of the gas required for a pressure maintenance plant.

Assuming the pressure maintenance plant continued in full operation for 20 years, it would consume a total of 8,400,000 Mcf of gas, or about 15 percent of the estimated yield. During this same period, a field produced on the depletion method would use about 4,400,000 Mcf of gas.

Recapitulating, these figures are presented in Table 1.

TABLE 1

ITEM	Depletion Method	Pressure Maintenance Method
Oil yield, percent of oil in place	20%	33⅓%
Gas yield, percent of gas in place	85%	85%
Oil yield, barrels	33,000,000	44,000,000
Gas yield, Mcf	54,400,000	54,400,000
Less Mcf. as follows:		
Allowance for gasoline plant fuel and shrinkage	6,000,000	6,000,000
Estimated field use	4,400,000	8,400,000
Estimated gas residue available for sale	44,000,000	*40,000,000
B.T.U. Available From all Available Products in terms of Equivalent of Gas. Oil at 6,090,000 B.T.U. per barrel and gas at 1,000 B.T.U. per cu. ft.		
Equivalent Mcf	245,000,000	308,000,000

* When available for sale, this gas is under high pressure.

Remember that a project such as has been analyzed promises an additional 11 million barrels of oil for California supply—and this at a fuel use of only 4 million Mcf more than would otherwise be required. This extra fuel amounts to less than ½ Mcf of gas consumption per barrel of yield. Surely this fuel is warranted. As for delayed gas production, who is to say that we shall not need the gas in the future as much as we do now? In fact, the release of pressure maintenance gas is already being written into estimates of the future.

A chart has been prepared to show what takes place under pressure maintenance, and the figures have been selected to conform to the numerical example which has been given.

Referring to the chart, note the trend of pressure decline prior to gas injection. This trend is positive, dependable, and predictable into the future. Compare the trend after gas injection. Note that shortly after injection begins the reservoir pressure is much higher than it surely would have been under depletion methods. The difference between actual pressure and predicted pressure under depletion method grows constantly. The inescapable conclusion is that well capacity is being kept up, because that capacity is dependent upon reservoir pressure. It is also fundamental that the longer that well capacity can

be maintained the greater will be the ultimate production of oil. This is what is taking place, and constitutes proof of effectiveness of gas injection.

Pressure maintenance has been successful in the first essential—pressure decline has been retarded to a great extent. Results in all of the reservoirs cannot be given because too little time has elapsed since gas injection began. The first major application, North Coles Levee, has sustained pressure to the extent that 23 million barrels of oil have been produced in the last 4½ years under pressure maintenance, with no drop in reservoir pressure since gas injection began. The original pressure at North Coles Levee was about 4000 pounds per square inch and the first production was under the depletion method, which continued until the pressure dropped to about 3400 pounds per square inch. The field has produced approximately 30 million barrels and thus the first 7 million barrels caused a reduction of about 600 pounds in pressure, whereas the remaining production or 75 percent of the yield to date has resulted in no pressure reduction.

Canal field produced 3,600,000 barrels of oil, January 1, 1943, to January 1, 1946, with a pressure decline of only 170 pounds. Prior to injection, the production of 1 million barrels of oil and associated gas caused a decline of 130 pounds. At Newhall-Potrero, where injection on full scale started in October, 1945, the pressure decline curve has been modified, indicating the same type of positive result as shown by the other two fields.

During the war the Petroleum Administration for War encouraged and urged operators to unitize oil fields and construct pressure maintenance plants. High priorities were given for materials for the wartime construction of such plants. At South Coles Levee a production allocation was withheld until such time as a plant was installed.

The extent to which California operators have backed up engineering plans with capital and expense is illustrated by the installed compressor horsepower for pressure maintenance and cycling operation, and the repairs to wells to avoid excessive gas production—especially reproduction of injected gas. A recent survey shows that machines total nearly 40,000 hp. These machines and the plants connected with them represent a capital outlay of about $6 million. Repairs to wells have cost some $3 million additional.

Cycling is a term applicable by common usage to the practice of conserving pressure in a condensate reservoir; that is, one like Paloma, where a huge gas cap overlies the oil accumulation. Cycling is the generally accepted and recognized method of producing from a condensate reservoir. This method, which has been adopted at Paloma, is designed primarily to obtain liquefiable hydrocarbons which would otherwise condense, become lodged in the sand interstices, and remain unrecoverable.

Engineers have calculated, with the aid of facts which were developed through API Project 37, and with other scientific data, that the present type of Paloma gas production, treatment, and injection will yield 44 million barrels of gasoline, condensates, and black oil more than would be produced by the ordinary depletion method; that is, by production of gas and sale of the residue.

It is true that the cycling plant uses natural gas fuel, but consumption amounts to less than 4 percent of gas throughput. Part of the fuel consumption represents only the immediate use of a future requirement; that is, gas returned to the reservoir is confined under high pressure which will be available to ship the gas through transmission lines when the gas has served its purpose in the condensate field.

Successful continuance of the Paloma plan will not only result in the greater yield of condensates, as quoted, but also in more crude oil yield. Furthermore, a large proportion of the estimated natural gas reserve will be available for sale. The operators have backed their engineers' conclusion and recommendations with $6 million. Results of processing are as predicted by the engineers. This fact not only is a credit to their skill but also to the soundness of the basic data which has been developed under sponsorship of the API. The Paloma project was initiated in wartime and despite shortage of materials, was authorized by PAW as in the best interests of our country. The plant needs no further justification, having already undergone the most careful scrutiny.

According to a survey published in proceedings of the API for 1945, there were in November, 1944, 37 gas cycling plants in the U. S.; 31 in Texas, 1 in California, and 5 in Louisiana. The combined processing capacity was 3 billion cubic feet daily and production was 49,250 barrels of liquid petroleum products daily. The plants represent an installation of 95,325 horsepower. (API Drilling and Production Practice, 1945, p. 117.)

Pressure Control by Gas Conservation

Operators in some fields conserve pressure by control of the gas oil ratio. In other words, instead of taking a large proportional part of the gas out of the reservoir and then replacing the gas, the well performance is so regulated that the gas oil ratio is kept low. High ratio wells are shut in. Such fields do not appear in statistics as pressure maintenance fields because they do not inject gas. But the practice of keeping pressure from wasting has the same type of economic justification as the pressure maintenance method. The conservation of gas in place in the reservoir accomplishes a result similar to that of pressure mtaintenance, because the gas which is thus confined causes a pressure to be exerted upon the oil in the sands. The gas, thus confined, becomes available for use as fuel after the gas has served its purpose in oil production.

The first essential of pressure conservation is to keep gas in the reservoir. Oil cannot be produced, however, without some quantity of gas. Thus the object is to extract the minimum cubic feet of gas per barrel of oil. This object applies regardless of whether a gas injection plant is in operation.

As an example of pressure conservation without gas injection consider an oil and gas reservoir which is producing 50,000 barrels of oil daily under careful production practice with the result that the gas oil ratio is only 600 cubic feet per barrel. The wet gas output is then 30,000 Mcf daily.

Now suppose that despite best efforts the ratio were 1200 cubic feet per barrel, and it was decided to return part of the gas for pressure maintenance. With the same oil production rate of 50,000 barrels daily the gas output would be 60,000 Mcf daily. If half of this gas were returned by gas injection we would have a pressure maintenance plant of the first magnitude — one injecting 30 million cubic feet daily. The result, however, insofar as reservoir pressure is concerned would be almost the same as is accomplished by the present practice of conserving pressure by conserving gas in its native place. The net output of gas would still be 600 cubic feet per barrel but this ratio would have been attained at great expense and considerable use of fuel. Thus, rather than produce excessive gas and then return it whence it came, the operators regulate wells to avoid overproduction of gas. Therefore, no huge compressor plant is seen in the field, there are no gas injection figures to report, and no publicity about gas conservation in the field—notwithstanding that operators deserve much credit.

Regardless of which method of production, either restriction of ratio of gas output or injection of gas, is adopted, only 30 million cubic feet of gas is available to the utilities each day.

Pressure conservation is practiced in varying degree. No field in California is expected to maintain pressure with no decline—the object is to adapt the practice to physical and economic conditions and do a reasonable job.

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TRENDS AND SUGGESTED IMPROVEMENTS IN Acidizing Procedure

By C. E. CLASON
Technical Adviser, Halliburton Oil Well Cementing Company

ACIDIZING of oil and gas wells to increase productivity is one of the foremost developments in production practices. However, acidizing is a science and unless properly applied may prove of little or no benefit. This article discusses factors and formation conditions which must be considered in order to obtain maximum results from acidizing.

THOUSANDS of wells in the U. S. and several foreign countries have been acidized in the past 16 years. Practically everyone in oil and gas production is now familiar with the use of acid to the extent that by simply pumping it out into a producing formation, the productivity of a well may be increased.

Best results are obtained where the formation provides a large amount of carbonates for reaction, or where the greater proportion of its composition is soluble. These facts being generally known, acidizing is considered to be a rather simple process, easily done with sufficient hauling and pumping equipment.

This can be true in some cases. Enormous increases in production have occurred through pouring acid down a casing and following with enough oil to displace it. This was an exception however, not a common occurrence, and usually in an old producing well.

New wells, acidized after drilling or perforating, have changed the picture in recent years. Deeper drilling, tighter formations, segregated pay sections and higher costs, both service and drilling, have called for effective improvements of a mechanical and chemical nature.

The first trend toward greater efficiency in acidizing was in using larger volumes or "shots" of acid. Efficiency, in these cases, meant greater results in proportion to the amount of acid used. This was an arbitrary figure, usually started by some operator and used by others in the same pool. If good results were obtained, this practice was followed more or less throughout the drilling in that vicinity.

Experience led to the belief that in some cases the figure for acid shots in a given area was set too high. Some wells apparently would turn out to be good producers with smaller shots of acid. Then the problem was thrown back to service companies and they were asked, "How much acid should be put in this well?"

It was very evident that any figure would be a rank guess, which could be either too high or too low. There should be some yard-stick of measurement devised, which if wanted could be used as an indicator. Acidizing in stages had been done in many places with the idea of making the channels and crevices larger near the well bore by repetitive shots. Perhaps further study could produce a logical method which would tie in with this practice and come closer to an answer. How did acid react under pressure and in motion? How long should a well be closed in after an acid job or stage? These questions all bear on efficiency in its proper sense.

Reaction Curves Study

Going back to the chemistry involved, work had been done in 1935 to establish time-rate of reaction curves between treating acid and both fast-acting and slow-acting limestones and dolomites (Figure 1). The curve was not a straight line, especially under a pressure of 800 pounds or more. Carbon dioxide evolved went into solution, giving a buffer effect which slowed the action of acid considerably, as compared with atmospheric pressure. This not only indicated a more definite period in which to just displace acid out into the formation, but also established a sufficiently fair pumping rate beyond which it was needless to go. Also with too slow a rate spent acid would be forced ahead but would remove no limestone because of its neutral state. With too much flushing fluid it proved that acid could be forced out too fast; in fact, it was possible to have a greater part of the reaction at points distant from the well bore, which could create bottlenecks.

Acid could be treated with a polyphosphate compound and the reaction delayed somewhat more, where desired (Figure 1). This treatment also served to equalize reaction between the calcium and magnesium constituents of a dolomite. The calcium carbonate normally reacts faster, liberating magnesium carbonate in suspension, which could have a plugging effect in a low pressure formation.

Thus one step was accomplished toward efficiency by giving a mark to shoot at when introducing acid into the formation. Any stage could be timed easily so that when the last portion had been displaced from the well bore, the head end of the acid out in the formation would have finished its action in widening the crevices. A well then could be opened for production after the last part of the acid had reacted.

It is evident from the curves that acid reacting while in motion will remove successively smaller amounts of limestone as it travels. If this is true, then channel or crevice widening will be a constantly decreasing action. More acid will react near the well bore than at advanced points toward the limit of penetration. This action is strictly in accordance with obtaining good flowing conditions and will allow the maximum for all contributing channels with less resistance to entering the well bore. Faster pumping to displacement will tend to approach a condition of uniform limestone removal, or widening, which will not permit as much flow into the well bore, hence too much speed is unnecessary.

After accepting the indicated method of acid introduction to best advantage, the next question was, "What can be expected from an acid treatment?" Aside from the actual oil or gas content of the reservoir why do some wells respond to small treatments and others require more to make the same size well? Does the type of porosity and permeability, or well condition determine results?

Figure 2, taken from Morris Muskat's findings,[1] shows that in a uniformly permeable and porous formation the increase in permeability to ten times or more over the original does not have an enormous effect upon increase of production. Extending this curve, we see

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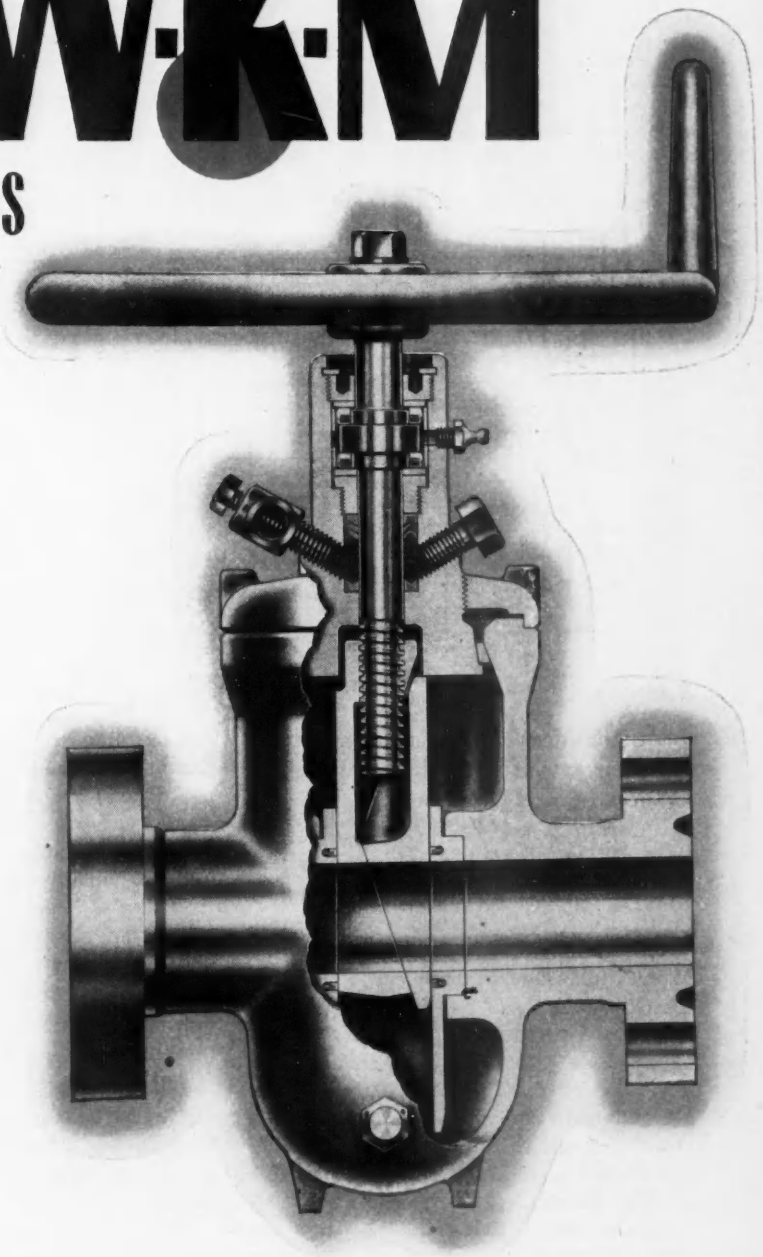

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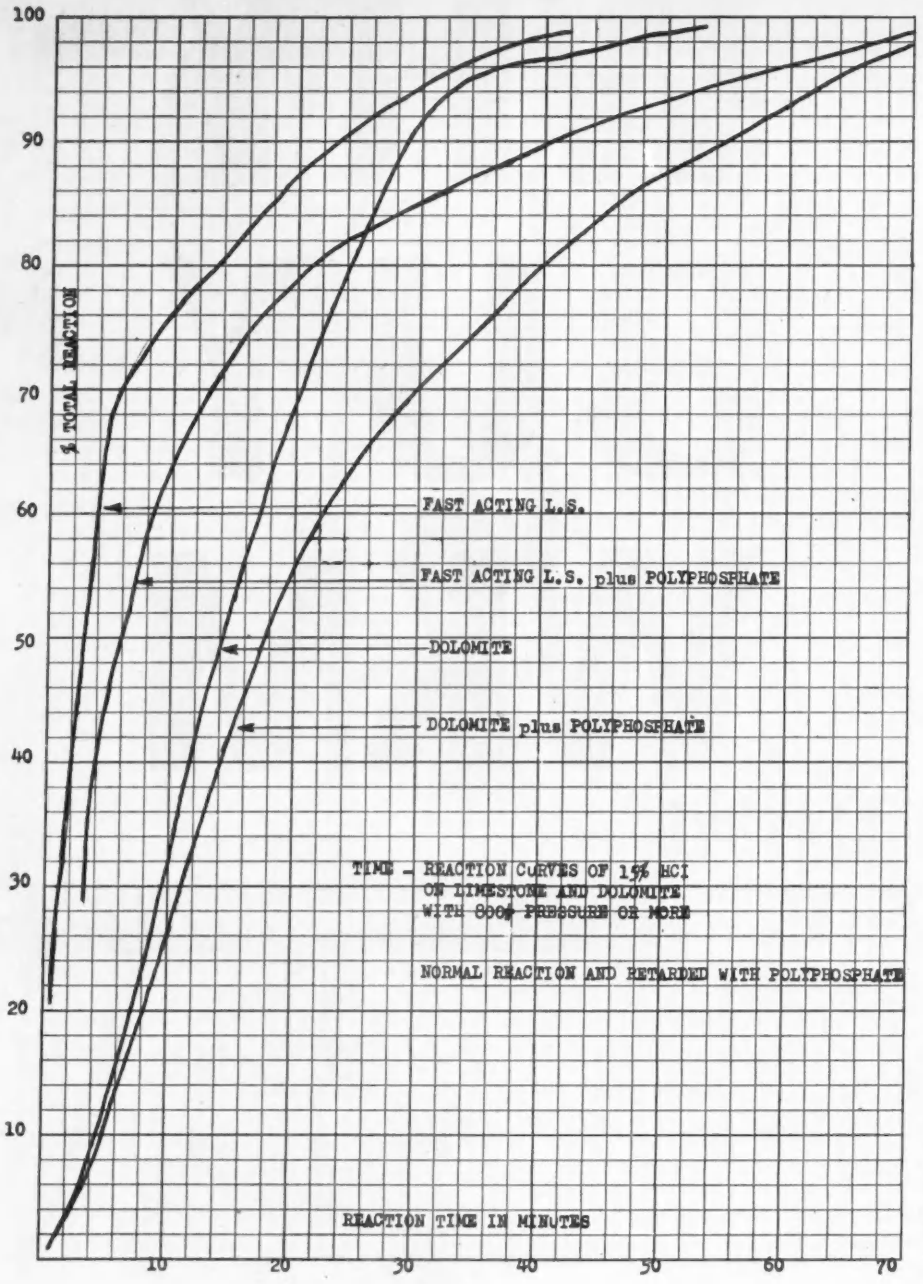

FIGURE 1

that the permeability increase would have to extend outward radially about 70 feet from the well bore to triple the production.

Figure 3 shows the volume of a like formation of 10 and 20 percent porosity with 100-foot thickness. Twenty thousand gallons of acid would penetrate about nine feet radially in a 100-foot thick section or 18 feet in a 25-foot thick section, with 10 percent porosity. Calculations or extending the curve show that it would take about 70,000 gallons to penetrate and fill a 25-foot thick section outward to 30 feet. And according to Figure 2, the best results obtainable would be about 130 percent above the original. With twice the porosity the penetration would only be one-half as much, (15 feet), or about 95 percent over the original for increased production.

According to Muskat, it is very apparent that enormous increases from use of acid are due mainly to two conditions and often a combination of both. First, the removal of mud or packed material introduced during the drilling from the well bore and closely adjacent pores and channels. Second, formation delivery through cracks and crevices.

The first condition means that the normal permeability of the formation is obscured and cannot function. This is the first correction to be made in acidizing and usually does not call for a large volume of acid, although water and mud losses when drilling in can produce extremes.

The second condition means that channels and crevices allow much greater distance of travel for the acid and by their enlargement much greater drainage area may be affected. The widening of various sized crevices with successive shots of acid can increase their flowing capacity many fold. It is theoretically possible to increase the production capacity of a fracture of .05 mm. width to 160 times its original with four stages of treatment. Many cracks and crevices are irregular, possessing natural bottlenecks, which are opened, so that the entire system and its tributaries are benefited.

In all cases, the widening of crevices or enlarging flow channels in the zone of turbulence in the converging area near the well bore gives greater relief in permitting passage of oil or gas. Indications are that successively larger stage treatments will accomplish more in raising the production of a well than the same total of acid in one shot.

It is possible then for structures susceptible to acid treatments to lie within or near these two extremes, either approaching the condition of uniform permeability or that of a strictly channel or crevice type. The latter can possess so many crevices that in effect it is nearly like a uniform sand body.

When a more uniform permeable and porous condition exists it can be seen that acid will act to produce the maximum increase in deliverability of the well quite near to the well bore. It has been shown that not too much can be expected in the way of increased production even if the permeability has been increased at a distance that would not be practical to reach with acid.

A well with a strictly crevice formation may prove to take considerably more acid and pay off, or give good results with smaller volumes because of covering more distance from the well bore, due to fewer crevices. Each formation will have wells in which there will be a maximum point of permeability beyond which no more production will be obtained for that particular bottom-hole pressure. It may cost too much to gain more permeability for the amount of oil or gas to be expected. On the other hand, some wells have had too much acid for the amount of production, because a large shot was used when a lesser amount could have as good results.

Suggested Pattern for Treatments

With the foregoing in mind, it was suggested that acid treatments in successively larger stages should give an idea of the type of formation, provided results are checked from each stage.

At the same time, if the depth of the pays are known, even approximately, it can be figured how far a given volume of acid will penetrate, provided there is some knowledge of the porosity. And then if stage treatments in larger amounts give increases much greater

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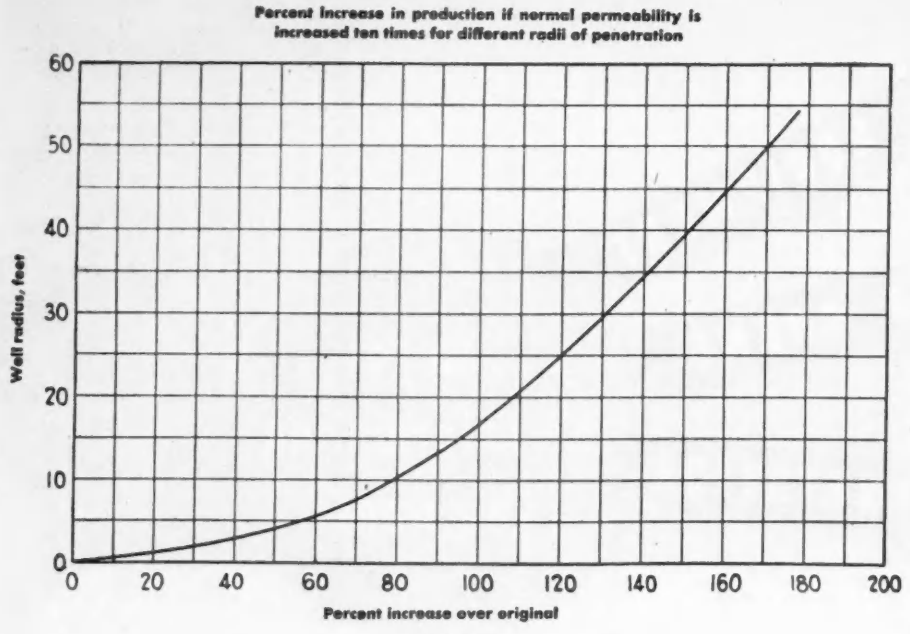


FIGURE 2

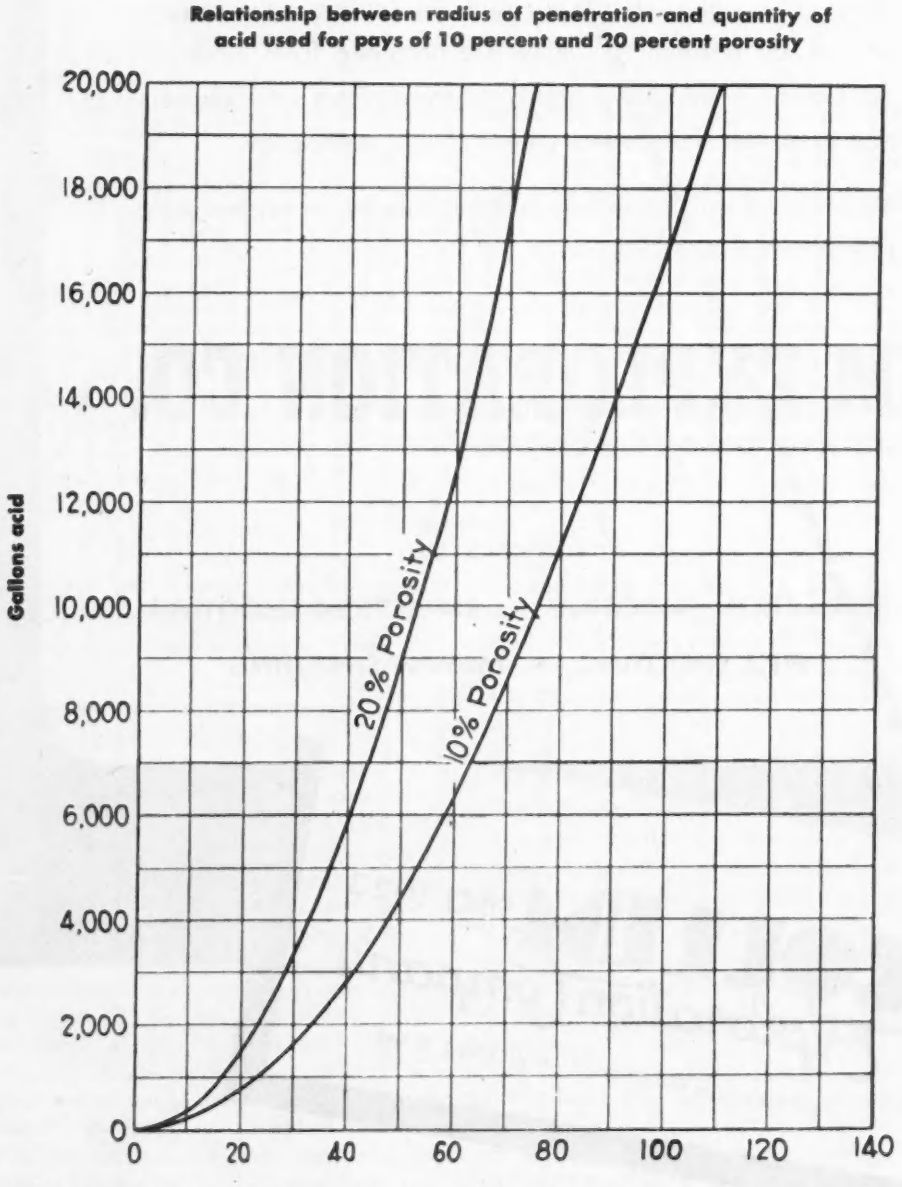


FIGURE 3. Radius of penetration in inches for a 100-foot thickness of uniformly permeable pay.

than could be expected from a situation as shown in Figure 2, it is known that crevice conditions exist. Plotting the results from acid stages will show the trend and should give a clue as to the advisability of more acid.

Even without knowledge of pay thickness, porosity, etc., much may be learned as to amounts of acid and expectancy of results.

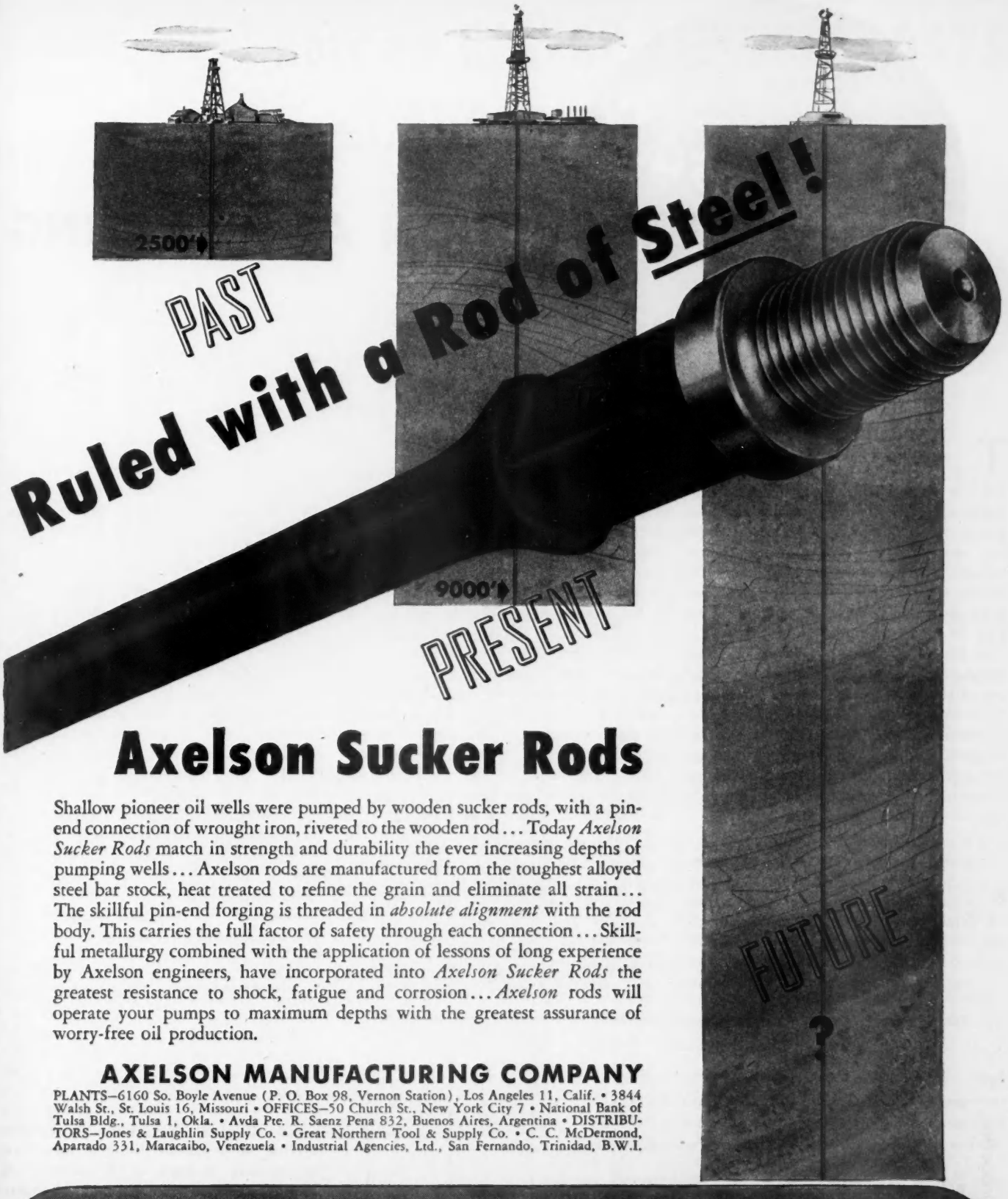
In all cases, the first step should be to clean out the hole and ends of channels, etc., at the well bore. This should be done, not only to restore normal permeability but to avoid washing material back into crevices and channels, and hindrance to acid penetration on the next stage. A small amount of 5 percent acid sufficient to fill the open hole or cover perforated pays, is sufficient when just displaced. Sometimes this can be repeated if much material is circulated or blown out. Then if it is a gas well, a Pitot tube reading can be taken to see if this procedure has helped to increase the flow.

Next assume that in this well the pay section is such that 500 gallons of acid will give some penetration. Even 1000 gallons will not be too much unless the well is one of those that are too close to a water drive, in which case small treatments may be all that are advisable. But assuming another kind, pressure out this stage. If a flowing well, it will not take long to get results. If a gas well, the same, only easier, but a pumping well will take longer, and following jobs will have to be done on other days.

In most cases 500 or 1000 gallons (depending on the amount of formation), should determine whether there is a well or pay worth proceeding with. To penetrate twice as far, 2000 or 4000 gallons will be needed. If no improvement or only a small gain is made in actual volume, the chances for more oil or gas are not good. But if the percent gain is enough in barrels or cubic feet of gas to account for more than twice the travel of the acid as shown on Figure 2, crevice conditions undoubtedly exist and the first point of measurement has been made. If the size of the oil or gas well, or production from a pay section is large enough, it may warrant larger amounts of acid. This again goes back to the maximum permeability for flowing conditions in a given area or pay section. In places where 100-barrel wells are a good size, no amount of acid will make a 500-barrel well.

Some wells will warrant going on to 8000 or 16,000 gallons and checking results in the same manner. Others may warrant only twice as much acid as the previous shot if there is doubt as to justification for the expense. But by following this pattern with variations in the

• CONTINUED ON PAGE 158



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Condensate PRODUCTION AND CYCLING

By PARK J. JONES
Consultant

Part 13

When to Stop Cycling

THE present value of in-place condensate varies with the ultimate condensate recovery and the volume of gas which must be produced. The latter is less than the in-place gas for either expansion or pressure maintenance with water; whereas for cycling followed by expansion the volume of produced gas may be 1.2 to 1.8 times the in-place gas. The life of a cycled reservoir may be substantially longer than that of either one of the other two producing methods. So economics as well as ultimate liquid recoveries is significant. In this article, the influence of the degree of cycling and pressure maintenance with water on ultimate condensate recovery and volume of produced gas is indicated.

Rich Gas After Cycling

Suppose gas injection is stopped after cycling some volume such as 40, 60 or 80 percent. Composition of production by expansion after cycling is equal to the volume of rich gas in production corrected for condensation. At the time cycling is stopped, composition aside from condensation is X_d and the rich gas in place is $(1 - C_d)$. The prospective volume percent rich gas in production declines from X_d to a value which is not likely to be less than $(1 - C_d)^2/X_d$. The data in Figure 13-1 are for the X_d curves in Part 12. The initial point for any line is X_d. The terminal point for any line is $(1 - C_d)^2/X_d$. The indicated rich gas volumes corrected for condensation give the approximate composition of production by expansion after cycling. The procedure is in terms of the rich gas initially in place within the invadable acre-feet of a reservoir. For no cycling $C_d = 0$, $X_d = 1$ and the rich gas in production aside from condensation equals unity as in Figures 2, 3 and 4 of Part 12.

Liquid Reserves for Gas A

Figure 13-2 shows the estimated composition and cumulative liquid recovery for gas A. Curves 1 are for cycling at or above dew-point pressure until the total volume of produced gas is 1.8 times the volume of rich gas initially in place. Curves 2 are for cycling to 0.8 volumes followed by expansion to 10 percent of dew-point pressure. Curves 3 are for cycling to 0.4 volumes followed by expansion to 10 percent of dew-point pressure.

Let the economic limit be 15 barrels per million for a cycling plant and 8 barrels per million for a non-cycling plant. Cycling below 15 BPMM would be at a loss. At 8 BPMM, a non-cycling plant becomes a compressor plant. Extraction of less than 8 BPMM is at a loss. This loss decreases gas sales earnings. The liquid recoverable by cycling at compositions less than 15 BPMM is not reserve. The liquid recoverable by expansion at compositions less than 8 BPMM is not reserve. The foregoing economic data will now be used to estimate liquid reserve for expansion and for cycling followed by expansion.

The points of interest for gas A may be summarized as follows:

Volume of Gas Produced, Percent			Estimated Liquid Reserve, Percent
Cycled	Expansion	Total	
None	91	91	81
40	90	130	94
80	63	143	90

The cycling economic limit for gas A is 54 percent and 28.8 percent for non-cycling. The estimated liquid reserve for cycling to economic limit is less than for cycling stopped at 40 percent. A cycling absorption plant may be operated at 1600-1800 psi whereas a non-cycling absorption plant may be operated at 600-800 pounds per square inch. Expansion is to 10 percent of dew-point pressure and requires compressors on the upstream side of a plant. The data for cycling are relative to pressures at, or above, dew-point. Correct for condensation if cycling operations are at less than dew-point pressure.

Figure 13-3 shows the estimated composition and cumulative liquid recovery

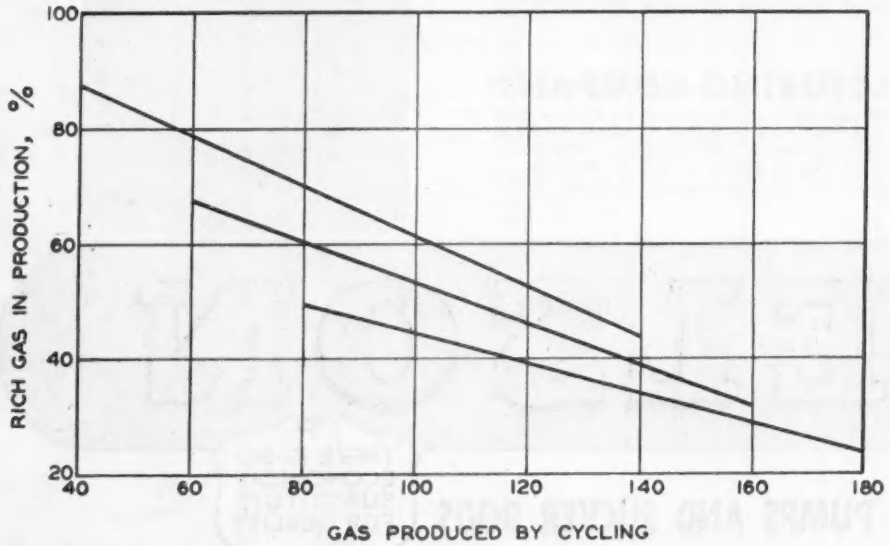

FIGURE 13-1. Approximate rich gas in production aside from condensation after cycling from 0.4 to 0.8 volumes at, or above, dew-point pressure; the data are for the X_d curves in Part 12.

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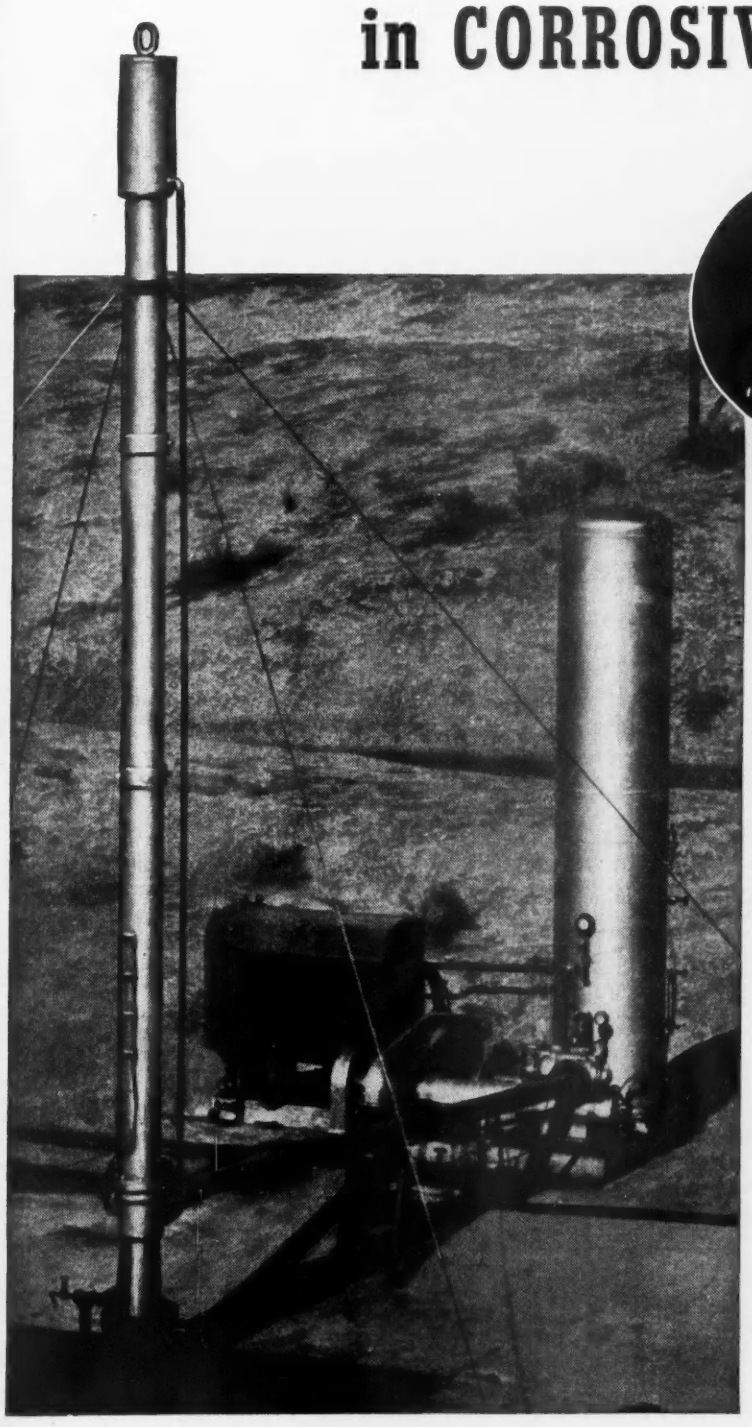

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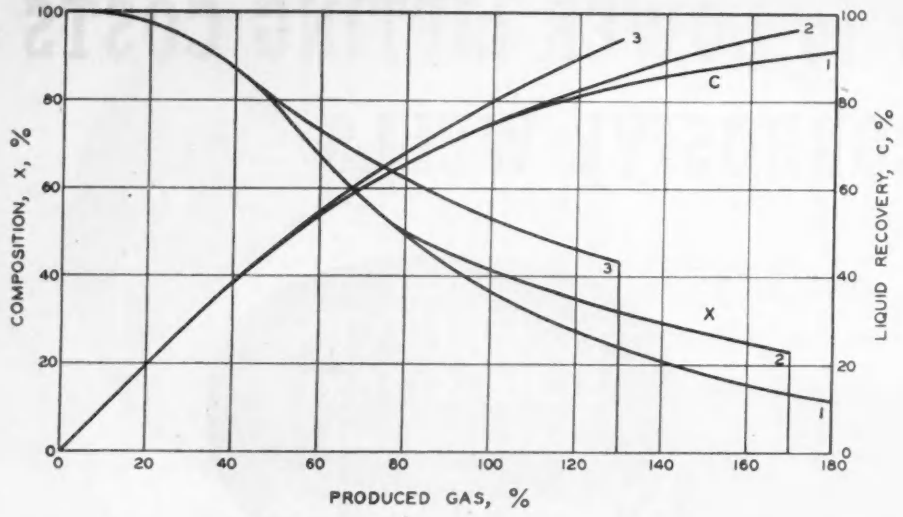

FIGURE 13-2. Estimated composition and liquid recovery for gas A cycled to 1.8 volumes, Curve 1; expansion of 10 percent of dew-point pressure after cycling to 0.8 volumes, Curve 2; expansion to 10 percent of dew-point pressure after cycling to 0.4 volumes, Curve 3.

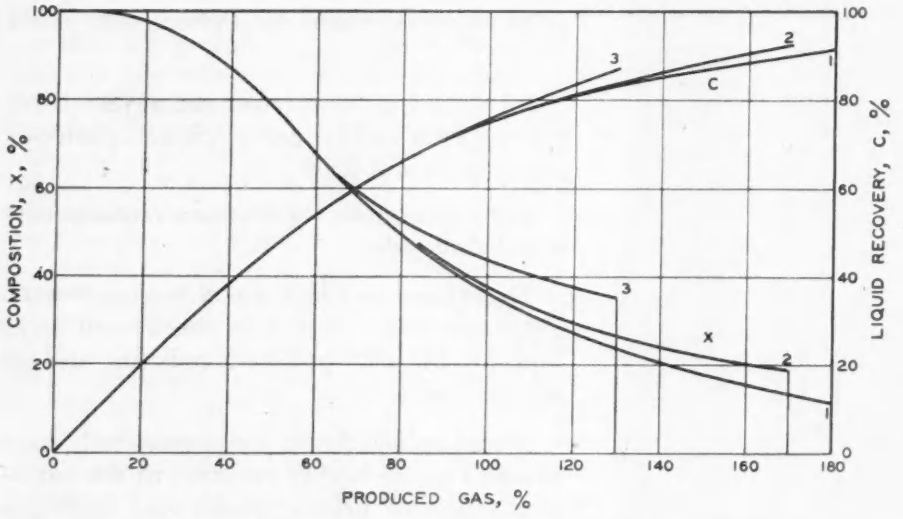

FIGURE 13-3. Estimated composition and liquid recovery for gas B cycled to 1.8 volumes, Curve 1; expansion to 10 percent of dew-point pressure after cycling to 0.8 volumes, Curve 2; expansion to 10 percent of dew-point pressure after cycling to 0.4 volumes, Curve 3.

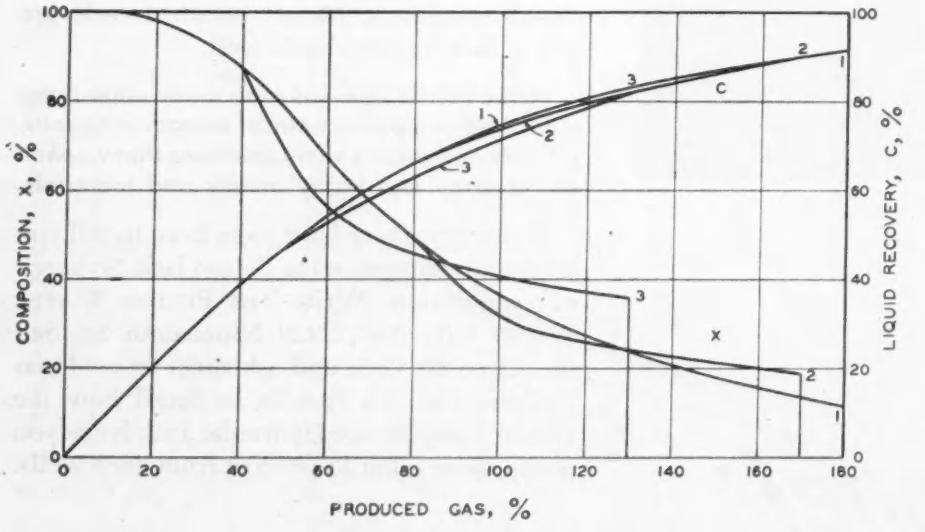

FIGURE 13-4. Estimated composition and liquid recovery for gas C cycled to 1.8 volumes, Curve 1; expansion to 10 percent of dew-point pressure after cycling to 0.8 volumes, Curve 2 to 0.4 volumes, Curve 3.

for gas B. The cycling economic limit is 30 percent. The non-cycling economic limit is 16 percent. The points of interest for gas B may be summarized as follows:

Volume of Gas Produced, Percent			Estimated Liquid Reserve, Percent
Cycled	Expansion	Total	
None	90	90	70
40	90	130	87
80	90	170	91

Expansion is aside from water encroachment, and cycling is at or above dew-point pressure. Correct the cycling data for condensation if volumetric input after shrinkage and fuel is less than volumetric withdrawal rate. Liquid reserve is in percent of butane plus in place at dew-point pressure within the invadable acre-feet of pay.

Liquid Reserve for Gas C

Figure 13-4 shows the estimated composition and cumulative liquid recovery for gas C. The cycling economic limit is 11 percent. The non-cycling economic limit is 6 percent. The estimated liquid reserve may be itemized as follows.

Volume of Gas Produced, Percent			Estimated Liquid Reserve, Percent
Cycled	Expansion	Total	
None	90	90	64
40	90	130	82
80	90	170	90

The foregoing liquid reserves are relative to no condensation during a period of cycling. The required initial makeup gas or water is about 20 percent of the volumetric producing rate for cycling. Expansion is aside from any water encroachment.

Injection of Water

Suppose reservoir pressure is maintained at dew-point pressure by injection of water. The curves in Figure 13-5 show the composition of production and liquid recovery for pressure maintenance by water on 40 or 70 percent of gas B. The corresponding data for gas C are shown in Figure 13-6. After water injection to 40 or 70 percent, production is by expansion. The latter is aside from water encroachment. The following points may be of interest:

	Gas B		Gas C	
Water injected, percent	40	70	40	70
Gas produced, percent	90	90	90	90
Liquid recovery, percent	80	86	76	84

The composition of production equals unity for production by water at or above dew-point pressure. After water injection is stopped, the composition of production decreases to the extent of condensation in reservoirs. This composition is richer than that in cycling operations. So production by expansion can be continued to either a lower wellhead pressure or a slower per-well gas producing rate.

The wellhead pressure P_w required to

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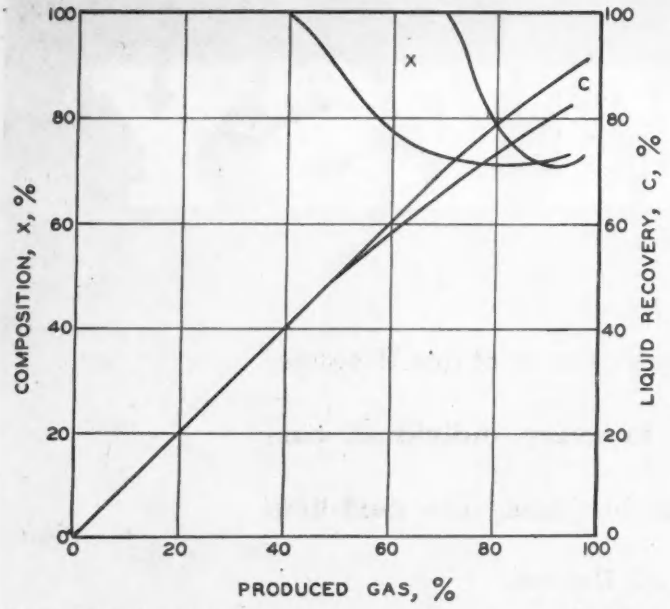

FIGURE 13-5. Composition and liquid recovery for pressure maintenance by water on 40 or 70 percent of gas B.

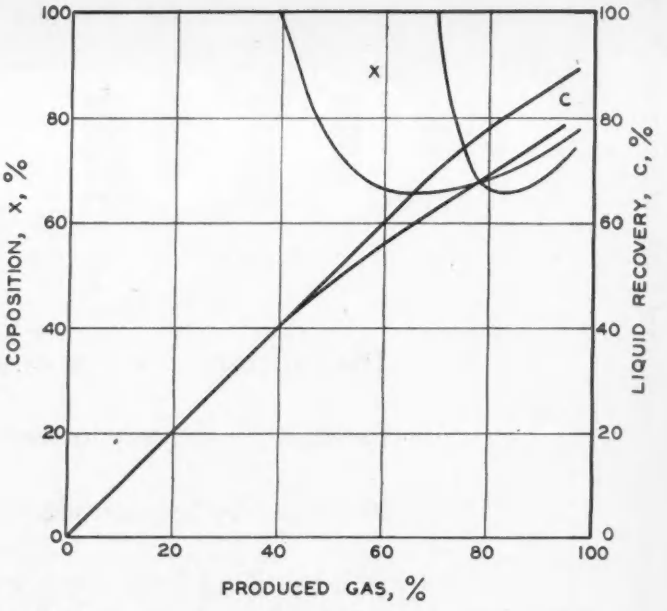

FIGURE 13-6. Composition and liquid recovery for pressure maintenance by water on 40 or 70 percent of gas C.

inject water at the rate of Q barrels per day is defined approximately by

$$P_w = P_b - L(0.433 - 258 \times 10^{-9} \frac{Q^2}{D^{5.22}}) \quad (1)$$

where

P_b = bottom-hole injection pressure
L = depth of well, feet
D = I.D. of tubing, inches.

As the pressure loss by friction usually is small by comparison with the pressure build-up required to force water from the bottom of a well into a reservoir, equation (1) is accurate enough for most practical purposes. The above expression is a solution of the following general equation:

$$\frac{144dP}{\rho dL} = 1 + \frac{6fV^2}{Dg} \quad (2)$$

where

D = I. D. of tubing, inches
f = friction factor
g = 32.2 ft/sec².
ρ = density, lbs/cu ft
V = average velocity, ft/sec.

Equation (1) is a solution of (2) for specific gravity of water equal to unity and a friction factor equal to $0.0225D^{-.223}$.

REFERENCE

[1] Any text on flow of fluids in pipes.

Acidizing Procedure

■ CONTINUED FROM PAGE 152

starting point of acid volume to suit thickness of pay sections, the stopping point for more acid should be indicated. Some gas well pays have had as much as 20,000 gallons of acid in stages, with a total of 60 to 65,000 gallons in three different pays in the same well.

This method or pattern cannot answer beforehand how much acid to use in a well. But it should give an answer which when followed will prevent too much, and indicate more when needed. It is, of course, more important where large production is involved.

The crevice type of formation is far from being a uniform condition in a given area. This is evidenced by the variation in size of wells. It seems rather inconsistent then, to say that all wells should be acidized with the same amount of acid. No doubt increases in production will result, but some wells will not have reached their maximum and it is possible for others to be overtreated.

It is realized that small well pools exist that require only a minimum volume of acid, as indicated by past practice, to obtain good production. This minimum volume has been decided upon by finding that larger volumes were unnecessary, which is more costly than approaching from the other direction.

The above reasoning may be applied to different pay sections in a given well where they are segregated for acidization.

Specific Improvements

It long has been realized that core samples from a limestone formation did not give a true picture of the actual permeability of a well bore either at the time the well was drilled or after it had been produced. A process has been in use for some time which gives comparative or relative permeability of the entire open hole sections or different sets of perforations. This has a decided bearing on where to direct acid to open up sections of lesser permeability. It will show that, if acidized, perhaps one pay which is very open will reecive all of the acid at the expense of others.

There are a number of well-known tools, packers and devices for directing acid into the formation at the proper places, and allowing production tests, swabbing, etc., of separate sections.

Some improvements of a chemical nature are now well known and commonly used where needed. These are all in the nature of an aid to acid reaction. Wetting agents give better contact of the acid with an oil wet formation and act to destroy water blocking. Emulsion of acid with some oils is prevented, which has a direct bearing in some cases with entrance into formation channels and also the amount of bad oil following a treatment.

Methods have been in use for mud removal from both limestone and sandstone wells. Hydrochloric acid of proper strength combined with correct usage has proven to be a cheap, efficient mud remover. A high viscosity emulsion that has penetrated a permeable formation can be broken down, allowing the formation pressure to eject it more easily. It is known that a weak calcium chloride solution, rather than plain water, will be of advantage in washing sand wells.[2]

On the mechanical side where the original pumps used in acidizing had a 30-barrel per hour capacity and 1500 pounds pressure as the upper limit, there are now in use pumps of 330 barrels per hour and 5000 pounds working pressure. Many improvements have been made in packer rubbers and tools to withstand higher temperatures and pressures.

As a whole, acidizing services and methods are changing to keep pace with the growing demand for more oil and gas production.

References

[1] M. Muskat. Flow of Homogenous Fluids. 1937.
[2] *The Oil Weekly*, February 24, 1947.

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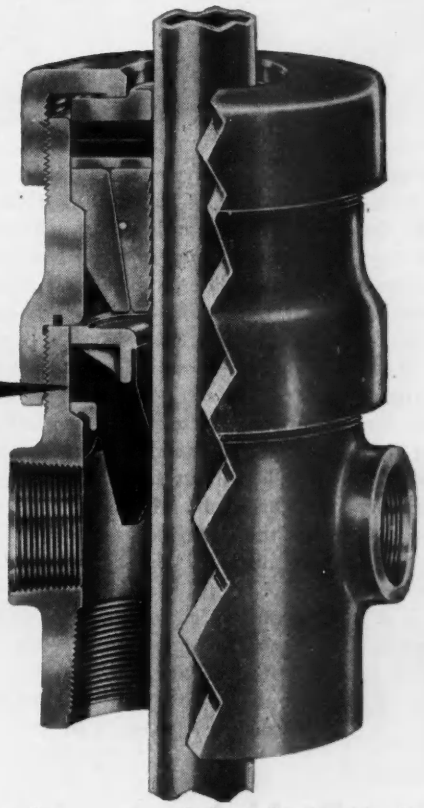

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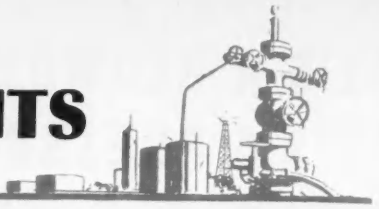

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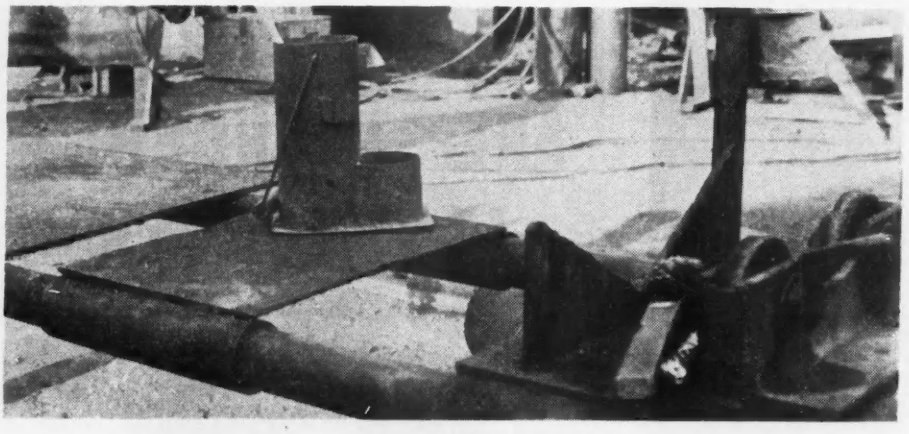
How To—Facilitate Shop Welding Operations with Handy Welder's Bench



Welding, both arc and acetylene, and allied operations form a very important phase of the maintenance and repair shops in any production camp or field headquarters. A veteran welder is usually a versatile individual, and with his tools can make many ingenious things. If given a free hand in his shop, he will devise unique devices which will aid him considerably in the efficient performance of his work. Illustrated is a combination of such ideas put forth by a welder wherein his job has been aided by the use of these devices.

Since the jobs required of the company welder are varied from hard-facing a valve seat to that of fabricating pressure vessels, his shop equipment must be flexible enough to handle each assignment. To accomplish the job with minimum of lost time in setting up work, and to put out high-qaulity welds, this versatile welding bench was made. It is merely a portable pipe framework set on pipe legs about 30 inches from ground level. In the case shown, the framework consisted of 2½-inch pipe. Top of the bench was not covered solid with plate steel as might be expected, but the horizontal pipe members were left exposed. During construction of the bench, several three-inch pipe nipples of predetermined length were slipped over the 2½-inch horizontal members to form a bearing for work-supporting platforms, each designed for certain types of work.

One such platform, as illustrated, carries a solid plate of sheet steel, each side of which is bead-welded to a pair of three-inch sleeves. Small objects, such as valves, may be placed on this area for repair welding. Such design makes it possible to move the platform over the entire length of the framework bench.

A similar platform was made in the same fashion, with the exception that a vertical vee-notched plate was welded to the platform as was a pair of rollers This section facilitated welding of long cylinders and piping that require rotating. Another set of rollers was permanently fixed at one end of the bench to provide the other support for cylindrical pieces. All these platforms were slidable along the bench framework and could be adjusted to suit the job. Large or small items could thus be placed on the bench and the welding job greatly facilitated.

In addition, a welding rod carrier, as shown, was made from salvaged pipe in which to store both long and short pieces of welding rods. A bucket handle provided a means of carrying the device from one spot to another. A saving in used rods has resulted with attendant savings in welding costs.

The complete unit has been of considerable help to the welder, and being at a desirable height, has eliminated cramped welding positions. Speed in completing jobs has brought about savings that have more than paid for the initial cost, which for the most part was labor since the material was mostly salvaged.

How To—Build Improved Rod Line Support

Use of sheaves or forked blocks for supporting rod lines frequently cause considerable wear at one point on the rod. A method used by some companies for eliminating much of the wear consists of a roller which can roll back and forth along a short path, the latter being a 30-inch long horizontal framework made of small diameter pipe and 1½-inch angle iron. The roller is a six-inch length of seven-inch casing which has a shallow groove turned on its center. The rod lays in the groove and as it moves back and forth, the pipe rolls beneath it. Since there is only point contact between the rod and roller, and with the roller free to move with little or no resistance, there is little occasion for wear on the rod.

The track framework is supported by short lengths of two- and three-inch pipe, the latter piece being the vertical member which is set in the ground. Cost to make and install such a unit is extremely small, and maintenance is practically eliminated.

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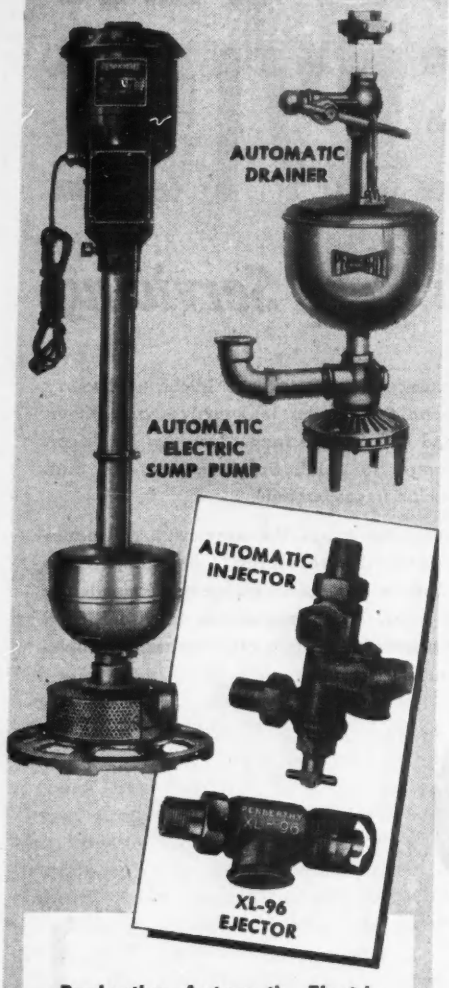

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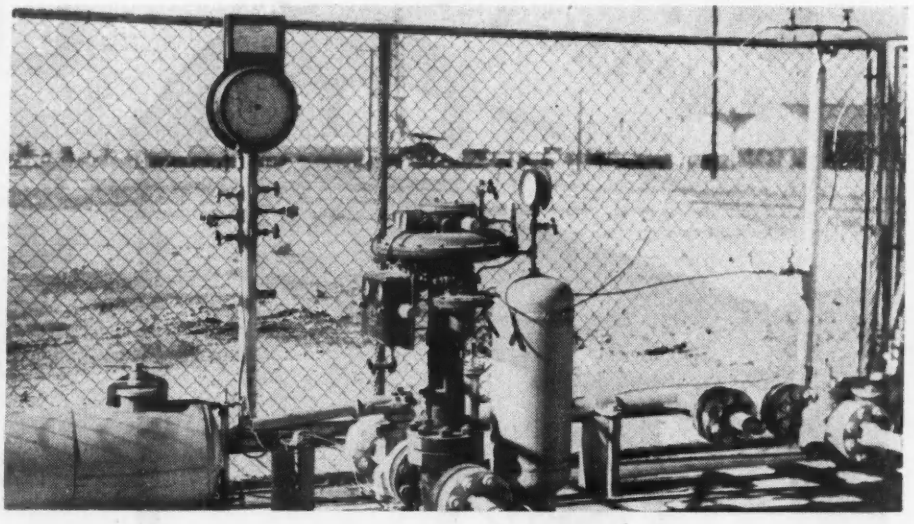
How To—Provide Dry Gas for Instrument Operation



Clean, dry gas can be separated from oil near the well head with a simple arrangement easily and inexpensively constructed. Containing a scrubber of its own, the unit furnishes dry gas at flow line pressure to perform three separate functions.

Acting as a surge chamber is a five-foot section of two-inch pipe welded vertically to the flow line leading to the lease separator battery. An orange peel head at the top of this riser supports fittings for copper tubing which lead the gas pressure required for instrument operation to a pressure cylinder set on a concrete footing. This cylinder acts as a scrubber to remove any moisture or condensed gases carried with the gas from the two-inch riser.

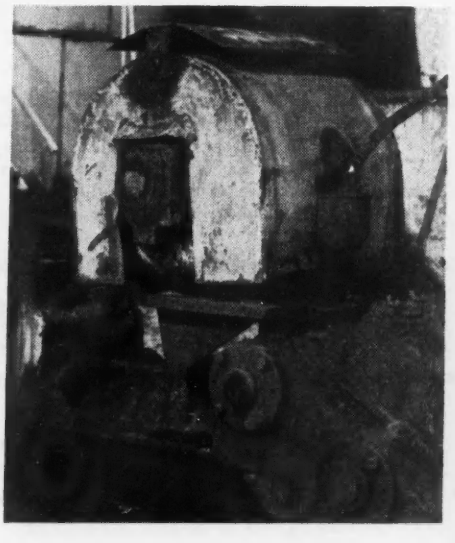
Lines from the scrubber connect to a recording pressure gauge, and to a pump which forces treating chemicals into the flow line. Also tapped into the five-foot riser is a pressure line which connects to the flow-line regulator.

How To—Protect Electric Motors from Weather

To protect the motor on a field pump from spray sometimes blown from the nearby salt-water disposal tank, one operator had welded a housing of light tank steel. The housing extends over the entire body of the motor, dropping vertically down on all four sides to near the base plate. A slot extends along the top of the curved portion of the housing to within two inches of each end. This slot, 1½ inches in width, provides ventilation for the motor and prevents overheating.

The housing does not fit closely to the motor, but has an air space of at least one inch at the sides. Over the slot, and raised on 1½-inch legs, is a curved section which excludes rain and spray from the slot, but which merely deflects or curves outwardly the current of warm air rising from the motor.

The bearings on the motor are not covered by the housing, which would complicate testing them for overheating. The motor housing is independent of the tank plate guard which completely encloses the gear reduction unit, protecting the spur gears from salt spray, trash, or intentional tampering.



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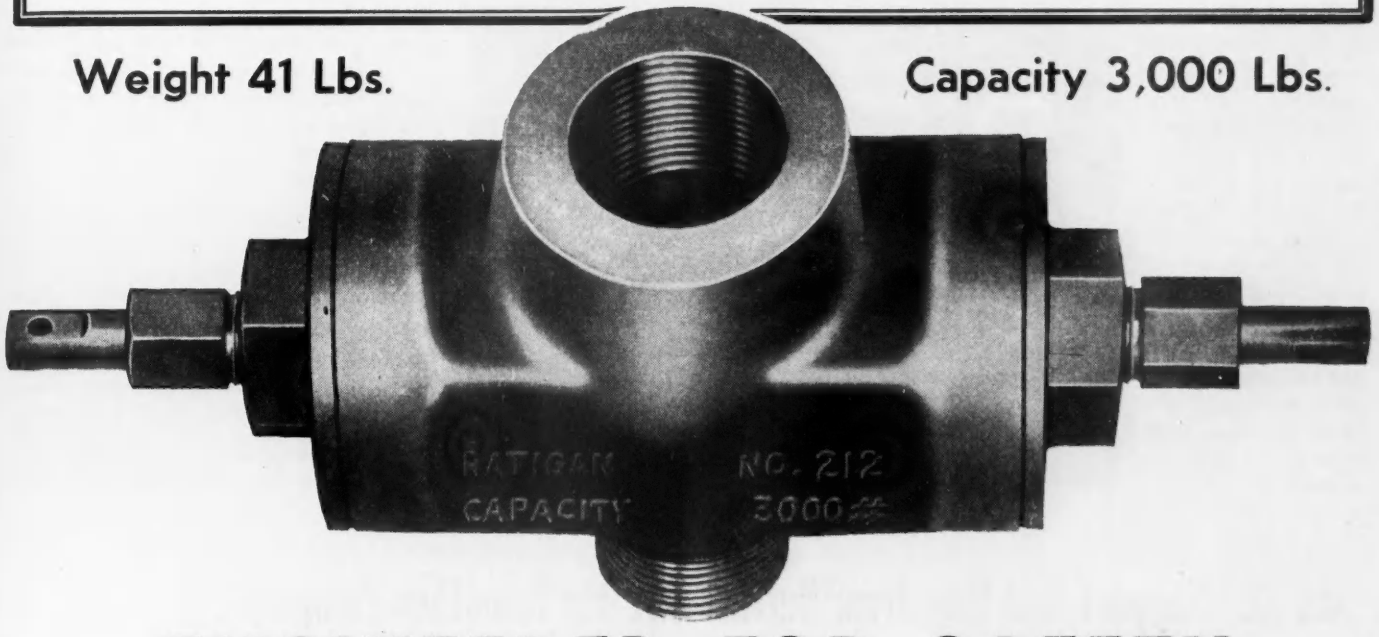

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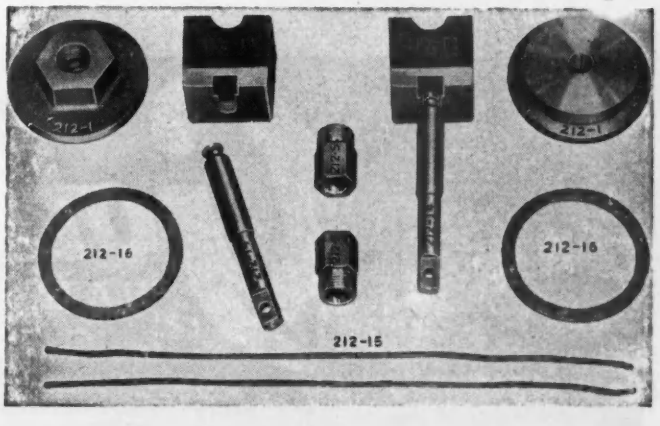
It is equipped with Ratigan new type retractable rubbers, which can be changed more rapidly by simply unscrewing the plugs at each end, when the old ones are readily accessible for replacement.

Two of these blowout preventers of the same size, with a nipple of any required length in between, make an efficient unit for swabbing. The device also can be used for running rods in wells that head or flow in the course of operation.

Made in 2½" and 3" sizes, both plain and upset. The 2½" plain type can be supplied in double-female, and if male and female are required a short nipple can be used to make the change. The 2½" upset can be supplied in male and female or double-female types. The 3" size is supplied in male and female types only; but the male connection easily can be converted to female by installing a 3" collar, making a double female unit.



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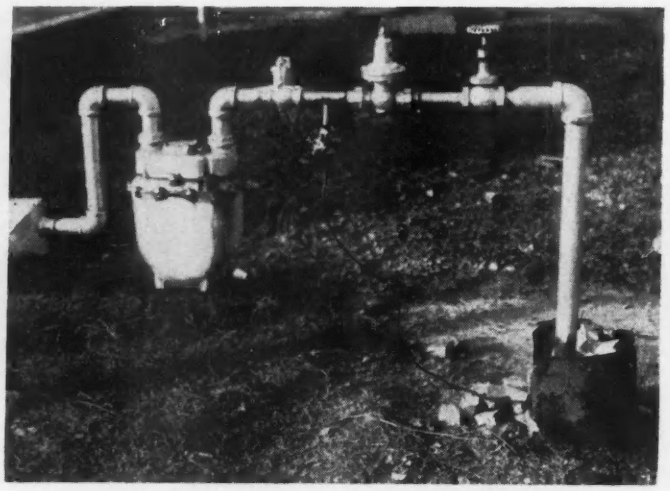
How To—Heat Fuel Line to Prevent Formation of Hydrates at Regulator

Hydrates forming on the downstream side of a pressure regulator can block the fuel line and shut down the pumping unit if the outside temperature drops enough to condense the vapors in the pipe. One producer assures fuel feed by tapping the fuel line just beyond the regulator, and carrying a ⅛-inch copper tube to a point near the ground at the riser.



An old bucket, paint can or other container is cut to enable it to be put around the riser, and then filled with broken rock, scraps of tile or bits of firebrick. The open end of the copper pipe is brought into this setting, the valve cracked open, and the gas ignited.

The packing around the pipe soon becomes heated by the flame, radiating sufficient warmth to the pipe to raise the temperature of the gas stream above its dew point, insuring a flow of dry fuel to the engine.

The heater tap is made at the bottom of the pipe so that any slight amount of fluid collecting will be drained off and burned in the heater fire.

How To—Support Rod Line from Derrick Girt for Smoother Pumping

Weight of the reins and adjusting turnbuckle at the end of a rod line for jack drive can cause considerable pound on the pumping equipment. This is extra severe when the rod line travels on a slope which is either above or below the plane of action through which the reins travel.

To relieve the pumping unit of this pound, one company supports the rod line just beyond the turnbuckle. A length of sand line is suspended from the derrick girt, usually about 50 feet up. On the eye or bight at the lower end of this line is a turnbuckle, its lower end hooked into the hand loop on the rod line turnbuckle end. By adjusting the vertical turnbuckle, the end of the rod line may be made to travel in an arc which, with a 50-foot radius, is practically a straight line. Any eccentricity or off-center pull of the line is taken by the sand line support, instead of the reins.

The supporting line inside the derrick girt does not strike the structure at the extreme outer end of the arc, due to the slope of the derrick and the point of attachment. The upper end of the supporting sand line is looped around a girt. The amount of movement there is negligible, and may be absorbed by the wire line without damage.

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How To—

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The appearance of a tank battery can be improved and the utility increased by building an all-steel stile for the dike or fire-wall which surrounds the installation. Common sucker rods, either ⅞- or ¾-inch, are used for the frame, which is laid out to fit the slope and the height of the dike where the stile is to be placed. The risers, or newel posts, are set vertically for welding hand rails at the top, for the safety of the gauger or pumper, and are finished smoothly at the welds to eliminate "wickers" and rough edges.

Two parallel rods are placed near the lower ends of the vertical posts so as to support the stair treads; the distance between these rods being adjusted to conform to the angle of the dike so the treads can be set for comfortable walking. The treads are made by using platform and stairway grating without risers so that mud and dirt can easily be scraped from boot soles and drop through the treads without accumulating on the tread.

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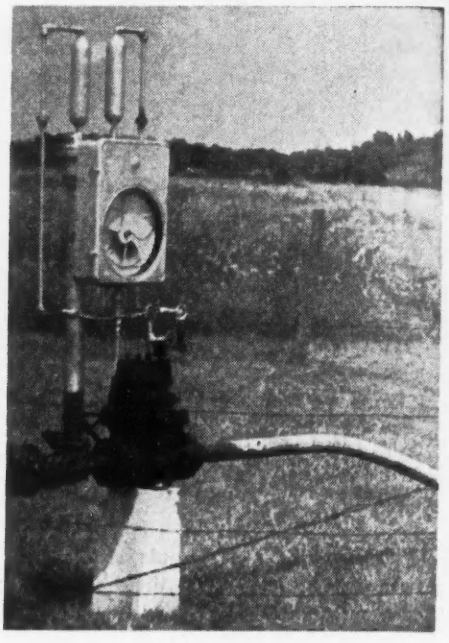
How To—Mount Orifice Meter and Plate Housing

A convenient and efficient mounting for an orifice meter has been provided to measure the volume of gas produced by one high-pressure gas well. The meter is located downstream of the separator and maintains a record of the gas used in a gas-lift project on an adjacent lease.

In this case, the flow of gas was practically steady and little or no vibration resulted. Therefore, it was possible to mount the meter support on a saddle strapped to the flow line. A concrete pillar was poured to extend about 20 inches above ground level. This was a convenient height for the pumper who must change meter charts and be responsible for the meter's operation.

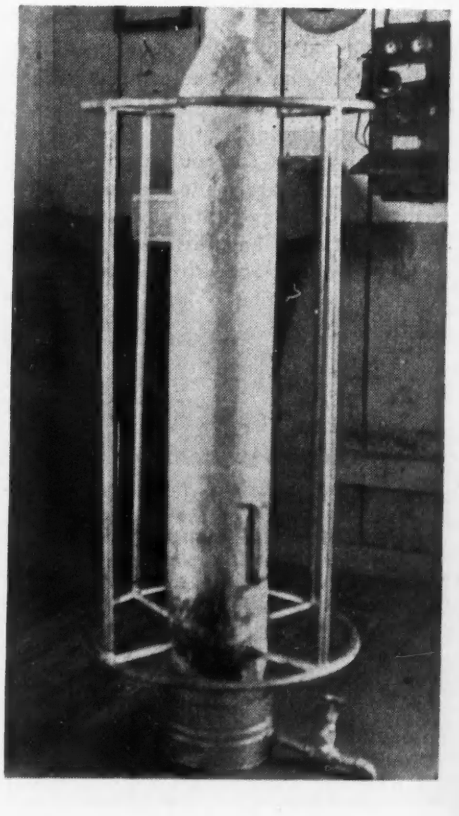
Elevation of the orifice plate holder above the gas flow line buried below ground prevented the accumulation of hydrates immediately downstream of the orifice constriction. If liquids did form, they were forced on down the flow line, and would not impede operation of the meter or the gas-lift system. Since both lines leading to and from the orifice meter are buried and form a firm anchor, no other bracing or means of securing the meter in place has been necessary. It is fenced in to prevent cattle from rubbing against the unit and possibly breaking some of the meter connections.



How To—Fabricate Simple Dog House Heater

The doghouse heater is a welcomed friend on cold wintry days. A simple, yet efficient, heater for doghouse, warehouse, changeroom or field office can easily be made from scrap material found on the average lease. It consists of a vertical section of 12-inch casing about five feet long. The bottom is welded to a square steel plate, 14 x 14 inches, and a hole cut near the bottom to provide entry for the gas line and burner. The upper part of the heater is swedged down to a four-inch collar which connects to a section of four-inch pipe to conduct the gases out the roof.

An additional feature has been added to prevent crewmen from accidentally touching or leaning against the heater. This protecting rail is made from ¾-inch sucker rod material and formed into two circles about 24 inches in diameter. These circular pieces are secured to the 12-inch heater by four short spoke pieces on each hoop. Four vertical rods are welded to each of the circular hoops to provide rigidity and act as guards. The complete unit is easy to construct and is easily removed from the doghouse.



Aluminum Pipe Lines for OIL and GAS

by H. S. BELL and C. ROSS HOLMES

HABITUAL THINKING of the oil industry assumes steel to be the only metal from which high-pressure lines can be built. This survey of the possibilities of aluminum, most common of the earth's minerals, as a line pipe material, shows the possibilities of this versatile metal to help overcome the present pipe shortage.

IT IS generally conceded that 1947 produced a crisis in the production of steel pipe for the oil industry. Deliveries are being scheduled as far ahead as 1951. In some cases, old pipe lines have been salvaged, reconditioned and relaid at great expense, exceeding that normally encountered for new lines. For emergency and quick deliveries, offers of double the mill list price have been made with very little material forthcoming. With the oil and gas industry contemplating necessary pipe line construction of nearly $1 billion, the situation is most serious.

There is one solution; that is in the use of aluminum. Extruded pipe in diameters up to 12¾-inch outside diameter is now available.

Heretofore, aluminum has not been considered by the pipe-line operators. The reasons may be summarized: (a) relatively high cost per pound compared to steel; (b) lower unit strength; (c) undeveloped welding technique; and (d) questionable supply in large quantities.

Relative Costs

The cost per pound is high, compared with steel at mill prices.

Extruded pipe lists at 32 to 34 cents per pound, dependent upon diameter and wall thickness. Quantity differentials apply. At present mill price per ton for steel, the aluminum pipe for any reasonable length of line would cost about six times that of steel. But certain factors disclose that the final difference is not so great as appears at first thought.

In the first place, and taking into consideration that suitable aluminum alloys have a yield point the same as steel used for Grade B line pipe, one pound of aluminum goes approximately three times as far in feet laid. Worded otherwise, and as an example, 25 tons of 10¾ inch by ¼-inch wall aluminum pipe will lay one mile of line, which would require 72.5 tons of steel pipe of equivalent dimensions and strength.

This factor alone reduces the difference to a ratio of 2:1. Carry this factor of light weight through all the other operations of laying a pipe line in the ground. Bear in mind that the cost of all these other operations represents 40 to 50 percent of the total cost.

First, we have freight from mill to distribution points along the line. Aluminum products are sold on a base price delivered to consumer anywhere in the U. S.

Then we have wrapping and coating that portion of the line requiring protection. The corrosion problem is somewhat different from that with steel, as later discussed, but if wrapping of the line is advisable, it may be assumed that about the same proportion will be necessary in the case of both metals. Due to the extremely smooth surface of the aluminum, competent protection specialists advise that priming will not be necessary, with consequent saving of 10 to 15 percent of the cost in this item.

Hauling and stringing pipe: think of the savings on this part of the job. One-third the tonnage, the weight of a 35-foot length of 10¾-inch x ¼-inch pipe only about 380 pounds, compared with almost 1300 pounds for a 40-foot length in equivalent steel.

Likewise, in lining up, a few men can handle the lengths with very little field equipment.

A study of welded circumferential joints discloses that roll weld or bell-hole weld beads may be run on in one-third the time. Considering that extruded aluminum pipe lengths will average 35 feet instead of 40 feet for steel, it is still safe to state that field welding costs may be cut in half.

When all of these factors are taken into consideration, the cost of an aluminum pipe line approaches much closer to that of a steel line than had been thought.

A general statement may be made that the costs will meet with steel pipe prices between $125 and $150 per ton f.o.b. mill. Charts of comparative costs and a comparison for a hypothetical line are appended (Figures 1, 2, 3 and Exhibit A). Many companies are paying this amount or more right now for a steel line; while others are waiting one, two or three years, upon some scheduled rolling at an

Table 1
Comparison Aluminum (61 S-T) with Steel for Grade B Line Pipe

	ALUMINUM		
	Typical	Guaranteed	Steel
Ultimate tensile strength, psi	45,000	42,000	60,000
Yield point	40,000	35,000	35,000
Elongation, percent	12–17	8–12	16–18
Specific gravity	2.70		7.80
Weight per cubic inch, pounds	0.098		0.293
Ratio	1.0		2.89
Coefficient of expansion	13.1x10-6		6.33x10-6
Ratio	2.06		1.0
Thermal conductivity	1500		305
Ratio	4.92		1.0
Melting point, °F.±	1080–1225		2500
Brinnell hardness	95		Var.
Decrease in yield strength 75-150 °F. percent	6.6		0.0

Copyright, 1947, H. S. Bell. This report was prepared under the authorship of H. S. Bell, of H. S. Bell, Inc., petroleum engineers, in association with C. Ross Holmes, pipe line engineer, and the H. A. Kuljian Corporation, engineers and constructors.

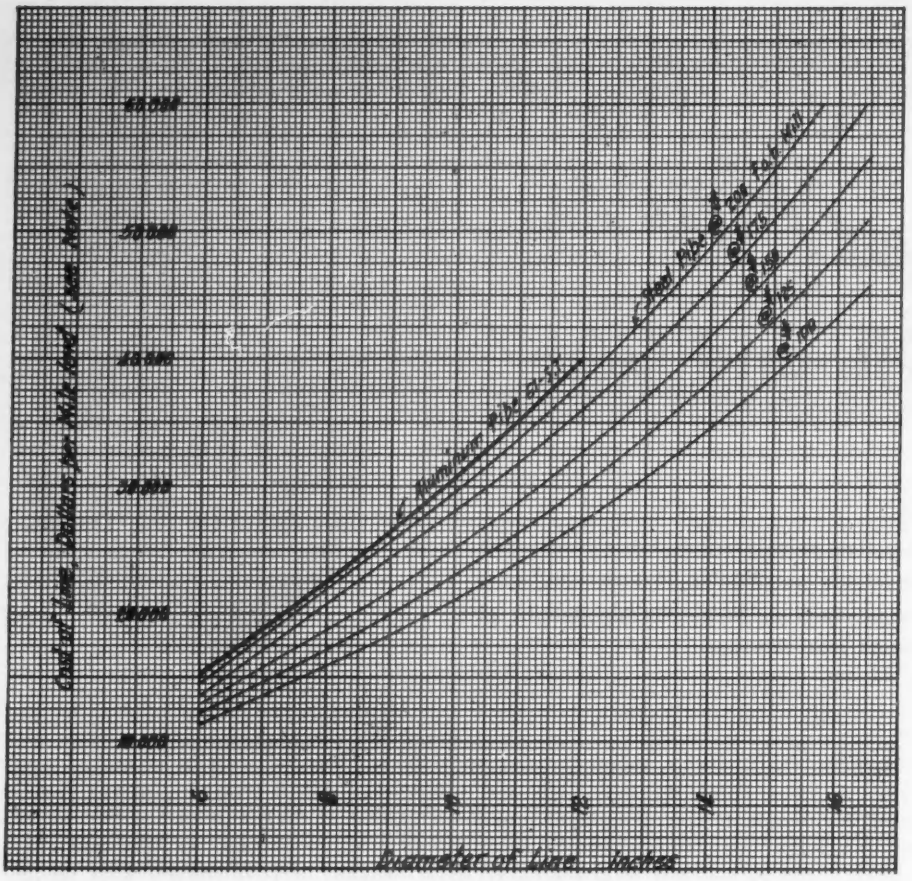


FIGURE 1. Costs of pipe lines. In all cases includes freight average 700 miles, haul and string, mastic coasting, tools and equipment. Does not include right-of-way, surveys, fencing and river crossings.

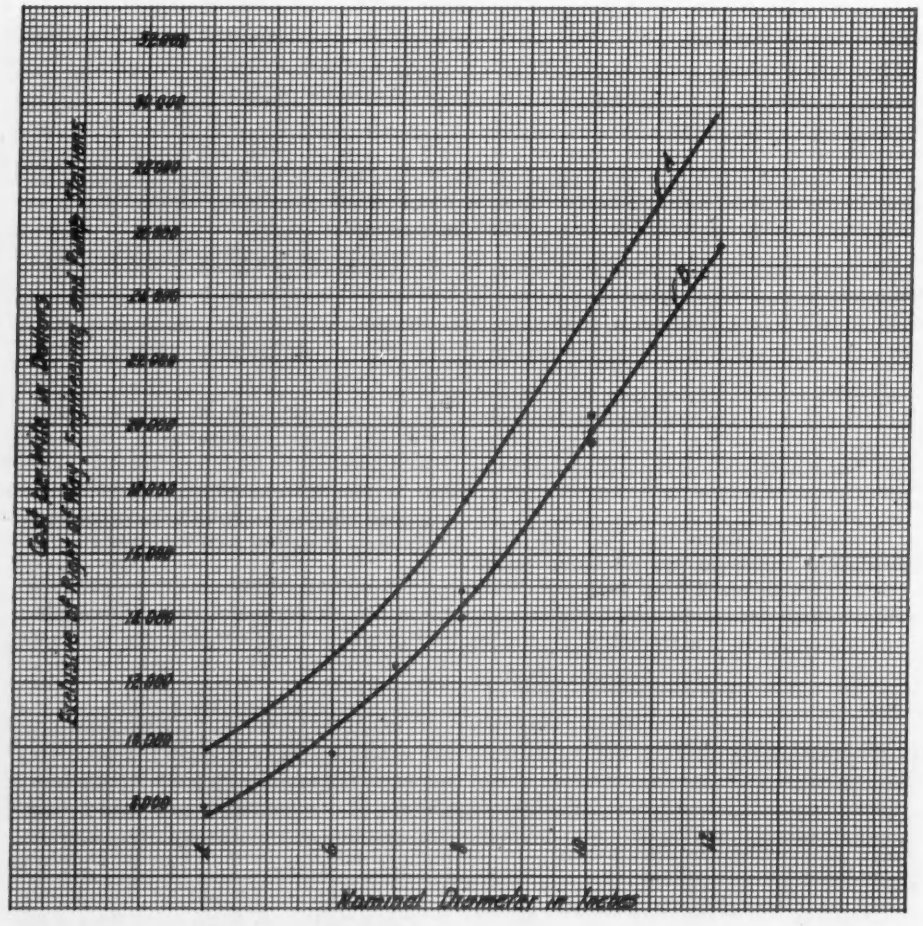


FIGURE 2. Cost of pipe lines. A—Estimate of August, 1947, aluminum pipe. B—Representative actual construction 1946-1947. Steel pipe at average of $100 per ton, mill. (Source: *Engineering News-Record*. Dodge Reports.)

indeterminate price. It is advisable to consider earnings possible over the waiting period. Aluminum pipe is available now.

Strength

For extruded pipe, Alloy 61 S-T is offered. This alloy has been used commercially for ten years and has a total of 15 years' testing experience. It is accepted as standard by both the Army and Navy for all structural construction where strength and corrosion resistance are required. All parts of standard pontoon bridges for the Army are being made from this alloy, also roofs and walls of oil storage tanks; and, furthermore, also gasoline and oil lines in airplanes.

Acceptance of 61 S-T alloy for invasion pipe after exhaustive Army tests is evidence of its value for pipe lines. The alloy has undergone successful soil tests for the last five years.

Alloy 61 S-T is a metal with 45,000 pounds per square inch tensile strength and 40,000 pounds per square inch elastic limit. The manufacturers guarantee 42,000 and 35,000. The latter figure is also the specification on steel for Grade B pipe. Basing the factor of safety on the elastic limit as in pipe line practice, we arrive at the same wall thickness for the same conditions for both aluminum and steel. Table 1 gives comparative strengths of aluminum and steel with technical data on other properties.

The research laboratories of the Aluminum Company of America have demonstrated techniques of electric welding of aluminum for a great variety of conditions. Standard practices long accepted for steel welding are applicable with but slight modifications. These methods are in daily use on a production basis, including the fabrication of high-pressure vessels, storage tanks, plant process equipment and piping.

Supply

Extruded aluminum pipe from 4½ to 12¾-inch OD in all standard wall thick-

Table 2
Diameter and Wall Thickness Tolerances Seamless Extruded Pipe

Diameter Tolerance* (in inches)

Nominal Diameter	Steel	Aluminum
4	0.04	0.050
6	0.06	0.075
8	0.08	0.100
10	0.10	0.125
12	0.12	0.150

Wall Thickness Tolerance* (in inches)

		ALUMINUM	
THICKNESS	STEEL All Diameters	Diameters Below 5 In.	Diameters Above 5 In.
0.500	0.062	0.028	0.045
0.375	0.047	0.021	0.035
0.250	0.031	0.016	0.025

* All values plus or minus.

nesses is available in quantity. Bearing in mind that one ton of aluminum pipe "lays" three times as much pipe line as one ton of steel pipe of the same specifications, presently available production capacity of extruded pipe will lay many hundreds of miles of line annually. The limit is extrusion capacity and the allocation of this capacity is and probably will continue to be on the basis of "first come, first serve."

The reasons already cited for past reluctance of pipe line companies to use aluminum have been overcome. In these times of extreme steel pipe shortage there is a rapidly growing interest in light metals.

Consider some of the technical problems:

Corrosion: Aluminum is not affected by many of the acids encountered in products and gas transportation. For these two uses, internal corrosion is eliminated or greatly retarded. The use of inhibitors and careful dehydration will not be necessary except in rare cases.

External corrosion from humus or other acids in the soil will be practically eliminated. Tests over long periods have been made; the results are generally available.

On the other hand, certain alkalies are corrosive toward aluminum. Hence soil surveys and protection for questionable areas are necessary as with a steel line. Some companies favor protecting the entire line, in accordance with their steel pipe practice. Facilities are available to apply shop protection if desired, at somewhat less cost than for steel pipe.

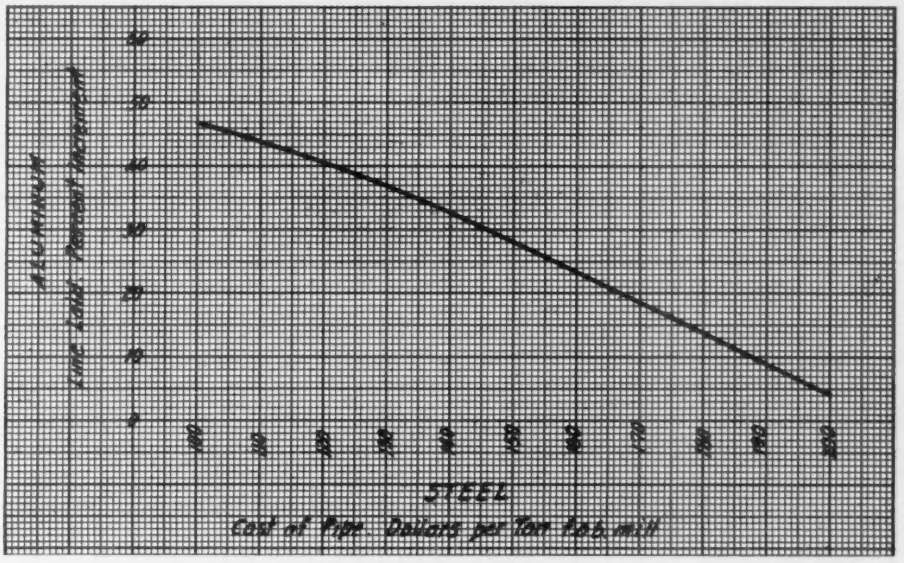


FIGURE 3. Percent increment in cost of aluminum pipe lines laid within U. S. vs. mill cost of steel pipe with average freight haul of 700 miles.

Effect of temperature: Aluminum, unlike steel, loses strength with increase of temperature in almost a straight line. Therefore, aluminum should not be used at temperatures above 150 to 175° F., without careful study and allowance for this factor. For example, between 75 and 150° F. there is a loss in yield strength of about 6½ percent. Since the above temperatures are rarely exceeded in oil or gas lines, the temperature effect on strength may usually be neglected.

Coefficient of expansion: It will be noted from the table of comparative properties (Table 1) that this coefficient for aluminum is about double that for steel. Aluminum lines should be laid with about double the number of serpentines per mile and with a slightly wider trench.

Friction factor: An inspection of a piece of extruded aluminum pipe discloses a remarkably smooth surface. As one pipe liner remarked, it was "almost like glass." No internal corrosion being involved, this surface stays smooth. Tests with water disclose that the friction loss with aluminum is 25 to 30 percent less than for equivalent diameter new steel pipe (Table 3). This differential will hold for most conditions encountered in the transportation of petroleum and its products.

This phenomenon becomes an important factor in pipe line economics. For a

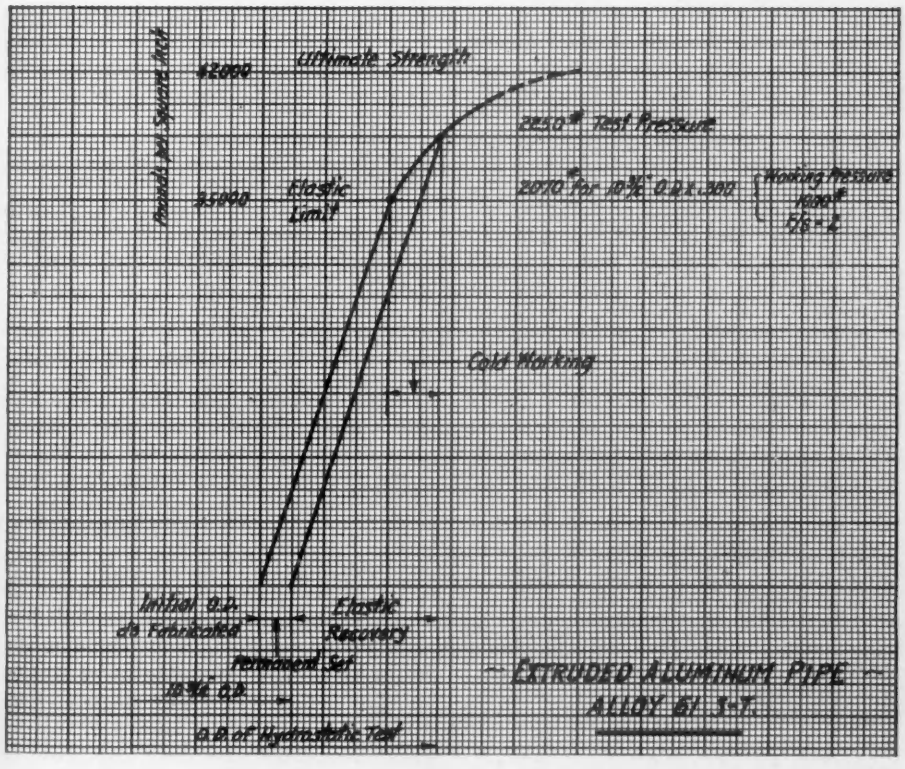
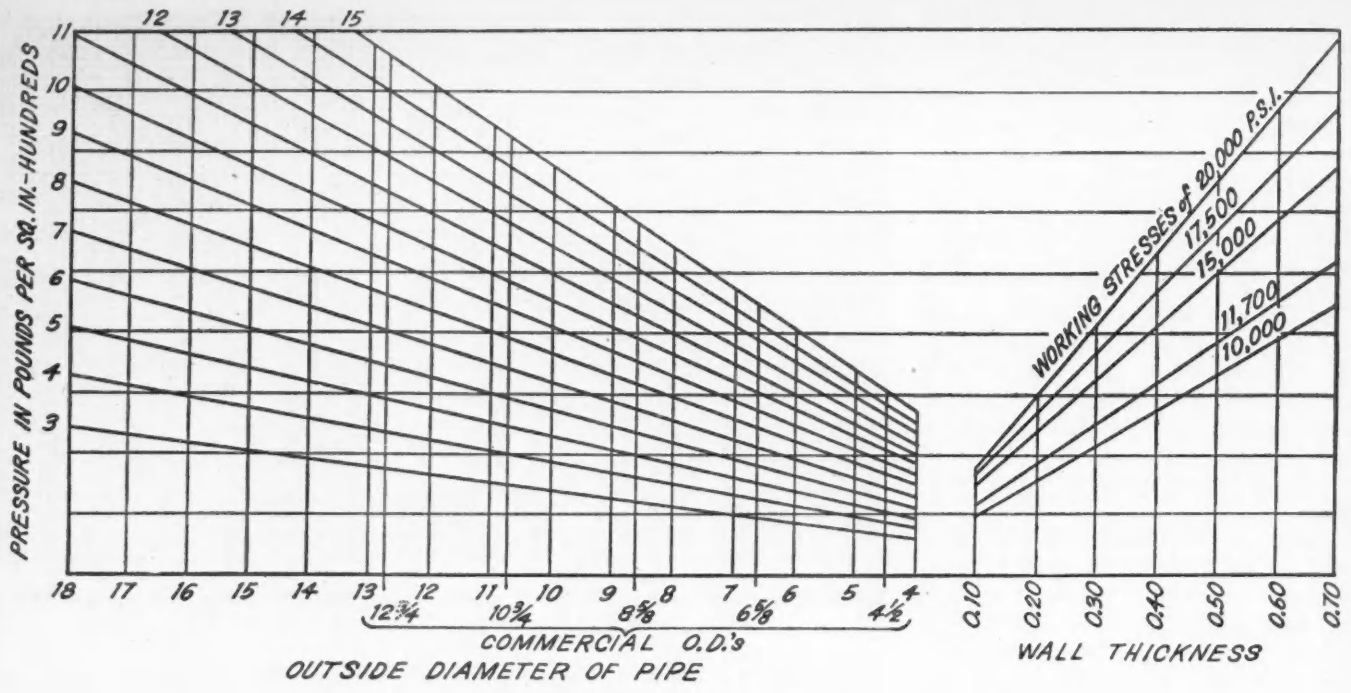


FIGURE 4

Table 3
Aluminum Tubing
Loss of Head in Feet per 100 Feet*
(Computed for Water)

Flow Gallons Per Minute	Inside Diameter in Inches		
	7.75	5.84	3.87
30	....	....	0.08
35	....	....	.11
40	....	....	.15
45	....	....	.17
50	....	....	.20
60	....	....	.30
70	....	....	.39
80	....	....	.49
90	....	0.08	.61
100	....	.10	.73
120	....	.13	1.00
140	....	.18	....
160	....	.23	....
180	0.08	.29	....
200	.10	.35	....
220	.11	.42	....
240	.12	.49	....
260	.14	.56	....
280	.16	.63	....
300	.19	.71	....
350	.24	.92	....
400	.30	....	....
450	.38	....	....
500	.46	....	....
550	.53	....	....
600	.62	....	....
650	.73	....	....
700	.83	....	....

* Abridged Table from Aluminum Company of America.



given diameter and flow, the power bills are materially reduced when aluminum is used. For the same expenditure, the flow is much more. Where the capacity may be definitely foreseen, often an aluminum line of smaller diameter may be used than would be the case were the installation to be of steel.

Tolerances: Table 2 shows comparative tolerances between aluminum and steel pipe. Diameter tolerances are slightly higher for aluminum; wall thickness tolerances are in favor of aluminum.

FIGURE 5. Seamless line pipe for safety factor based on yield point.

Stress	Grade A	Grade B	Aluminum
20,000	1.50	1.75	1.75
17,500	1.72	2.00	2.00
15,000	2.00	2.33	2.33
11,700	2.56	3.00	3.00
10,000	3.00	3.50	3.50

Curves based on Barlow's Formula

Comparative Cost Per Mile of Installed 8⅝" x ¼" Pipe Line
Working Pressure 1050 Lbs.

Per Mile	Aluminum	Steel
Tons per Mile	21	60
Costs:		
Freight	$.....	$ 375
Stringing	300	525
Trench and Backfill	2,100	2,100
Welding	700	950
Painting and Wrapping	2,500	2,800
Equipment Cost	1,500	2,550
	$7,100	$9,300
Aluminum Pipe at $640/Ton	$13,440	
Steel Pipe at $92/Ton (present mill)		$5,530
125/Ton		7,500
150/Ton		9,000
200/Ton		12,000
Total Cost, Pipe and Installation:		
Aluminum Line	$20,540	
Steel pipe at $92		$14,830
125		16,800
150		18,300
200		21,300

Assumptions:
Total length of line, about 100 miles.
Distance pipe mills to location, 700 miles.

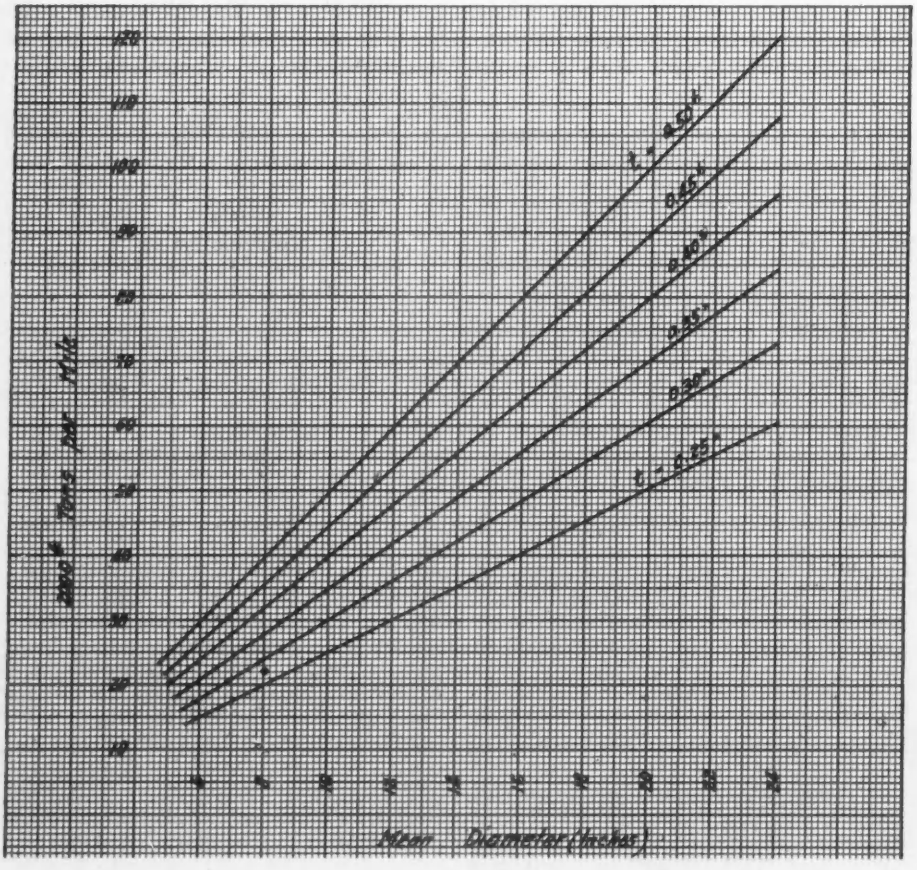


FIGURE 6. Weight of extruded aluminum pipe. Formula: Tons per mile = 10 × t × Dm. t = thickness, inches. Dm. = mean diameter. Allows for 2 percent weight overrun.

Mill lengths of aluminum pipe will range from 32 to 37 feet, dependent upon diameter and wall thickness. Length tolerance is plus or minus one foot.

Conclusions

Aluminum pipe lines may be laid at a cost comparable with emergency deliveries of steel pipe. They may be laid at costs 30 to 50 percent above lines laid with steel pipe at present mill price.

Aluminum pipe is immediately available, subject to prior sale, for almost any reasonable length of pipe line in diameters 12¾ inches and under. This permits many projects awaiting long deferred steel pipe deliveries to be started at once and thus to enjoy earnings over a sufficient period to amortize any increased cost before a steel line could be put in operation.

The Scene

Pueblo, Colorado

The Characters

Gas Company — Steel Mill

Know-how Contractors with "Caterpillar" Diesels

The Plot

Gas Company supplies gas to Steel Mill. Seepage from Steel Mill at underground creek crossing is eating away pipeline. Raising pipeline to overhead crossing is imperative. But—

Interruption means no gas supply. No gas supply means Steel Mill can't operate. Know-how Contractors have solution, to wit:*

*SELECTING a non-working holiday (July 4th), Contractors get organized. Spot "Caterpillar" Diesels on the job—a D7 and a D8 Tractor equipped with pipe-layers; a D6 equipped with winch and bulldozer. Action! Within twenty-four hours the job is done—the 20-inch, 90-pound-foot line is raised—Steel Mill keeps to working schedule without missing a beat.

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BECAUSE OF its high thermal efficiency and adaptability the gas-diesel engine is assuming an important place in the field of prime movers. This article describes some of the engine's more important advantages and presents comparative cost curves.

Economics OF GAS-DIESEL ENGINE

Six-cylinder Gas-Diesel engines in a crude oil pipe line pumping station in Colorado.

By R. A. DARLING

PROBABLY the most interesting development in the industrial power field during the past ten years was the introduction of the gas-diesel engine. Announced in 1945, this engine attracted the attention of the oil industry wherever gas and diesel oil were both available for fuel. Among the many advantages are the following:

It burns gas (natural, sewage, manufactured, etc.) on the diesel principle with better than full diesel thermal efficiency. It offers instantaneous convertibility from gas to oil fuel or vice versa at full load. It provides simple automatic control of the gas-oil ratio, guaranteeing fuel availability for full power in case of fluctuating or low gas pressures. It can be supercharged with complete success. After becoming aware of the above advantages engineers familiar with the uses of the diesel engine can envision several applications where a power plant having these characteristics would be advantageous. With the continuous widening of distribution of natural gas over the entire country and its increasing prominence as a source of industrial fuel, probably the most important advantages of the gas-diesel engine is its extremely high thermal efficiency.

The oil-burning compression ignition internal combustion engine has long been considered the most efficient prime mover. Its thermal efficiency is approximately 35 percent for peak performance. In the gas-diesel engine this efficiency has been raised to 40 percent, an increase of 5 percent. This is of profound significance to those familiar with the struggle entailed in raising the efficiency of the steam power plant and the gas turbine.

Details of the construction and the principle of the operation of the gas-diesel engine have been adequately covered in numerous technical papers. It is not the purpose of this article to discuss features of construction, but to deal with the economics of this development and how these improvements in efficiency can best be applied to the oil industry.

Although the gas-diesel has been recognized as an extremely economical machine at full load, this efficiency has dropped rather rapidly as the load was decreased below the full load point. The result was that at slightly under full load it became less economical to operate than the oil diesel engine, and at anywhere from one-half to one-third load it became less efficient even than the spark-ignited gas engine. For this reason engine builders have hesitated somewhat in recommending the gas-diesel for applications where the load factor was extremely variable. This condition usually obtains for generating stations, since their average load is often comparatively slight in spite of the fact that they are required to pull full load, or an overload, at frequent intervals. So, in the generating plant, the gas-diesel in some cases has cost more to operate than the spark-ignited gas engine.

Figure 1 gives a comparison of fuel consumption of various types of four-stroke cycle engines. Total British thermal unit fuel consumption of the various engines is plotted aaginst percent load rather than BMEP in order to give a true picture regardless of the full load brake mean effective pressure ratings of the various types of engines. The curves shown for the diesel and the gas-diesel are typical for a turbocharged engine. The naturally aspirated engines of these types will have the same form of curve but show a little higher fuel consumption over the load range. The fuel consumption for the gas-diesel was figured on the basis of burning diesel fuel having a high heat value of 19,350 Btu per pound. The amount of diesel oil used for pilot injection over the entire load range was figured as being equal to 10 percent of the total Btu consumption at full load. The Btu value of the gas used was assumed as 1000 Btu per cubic foot low heat value.

The poor showing of the first gas-diesel is brought out quite clearly by Figure 1. It is obvious that unless this curve could be improved the utility of the gas-diesel engine would be extremely limited. Only recently has it been discovered just why the fuel economy would fall off so drastically below full load. It was necessary to start from the basic theory behind this engine to develop an explanation.

The only reason that the gas-diesel will operate at all is because of the very lean mixture of the air and gas that is compressed prior to ignition. This mixture is so lean even at full load that a positive flame such as a pilot injection of fuel oil is necessary to ignite it. As the load falls off on the engine the gas is further reduced, making the mixture even leaner. In fact this mixture becomes so lean that the pilot flame will not completely ignite it. In effect the pilot flame literally burns a hole in the mixture, leaving a relatively high percentage of the gas to go out the exhaust unburned. A way has now been found of reaching that gas and burning it. As shown in Figure 1, the present-day gas-diesel will show a lower Btu consumption at any and all loads than that of oil diesels.

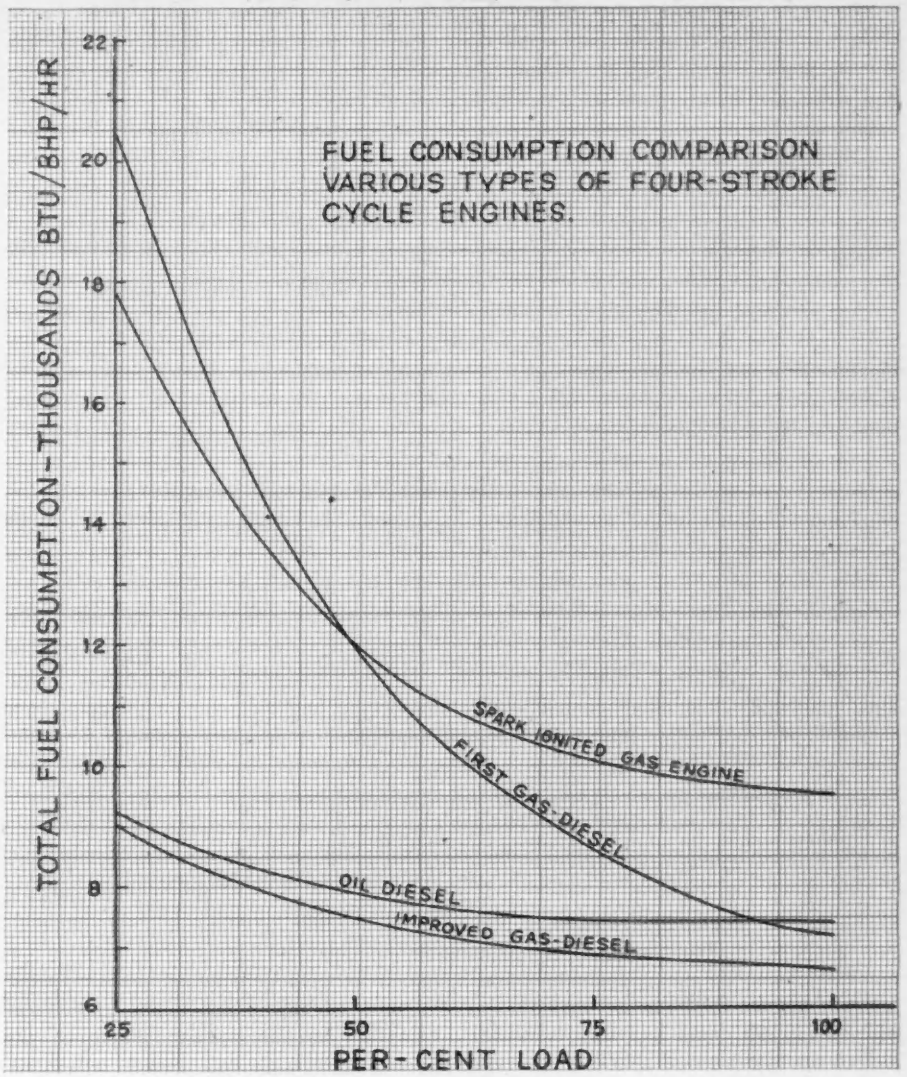

FIGURE 1

Thus it can be seen that the gas-diesel engine can produce a brake horsepower hour for less Btu, and it is only when we examine this high efficiency from a dollars and cents standpoint that the significant value of this engine is disclosed.

Engine Comparison

It has always been difficult to readily compare the gas-diesel with the oil diesel and spark-ignited gas engine because each user has a different set of fuel costs to consider. For example, the cost of natural gas is widely variable depending on the plant location, the amount of gas used, and the nature of the plant that is being considered. Also, the cost of fuel oil varies somewhat with the location of the power plant although not over so wide a range as the cost of gas.

Figure 2 shows the cost in cents per bhp per hour of fuel for a spark-ignited gas engine over a range of gas costs from 5 cents per 1000 cubic feet to 40 cents per 1000 cubic feet. Also, the cost of fuel for an oil diesel engine is shown over a range of fuel oil costs from 2 cents per gallon to 9 cents per gallon.

Figure 3 shows the cost of fuel for a gas-diesel engine with fuel oil varying from 2 cents per gallon to 9 cents per gallon and with gas varying from 5 cents per 1000 cubic feet to 45 cents per 1000 cubic feet.

An example can best be used for showing the difference in fuel costs for operation of the three types of engines. First, take the case of a power plant where gas is relatively cheap and fuel oil must be purchased at the prevailing market price. We assume that a user can purchase gas at an average figure of 20 cents per 1000 cubic feet and fuel oil at 7 cents per gallon. Which engine will prove more economical, all factors considered?

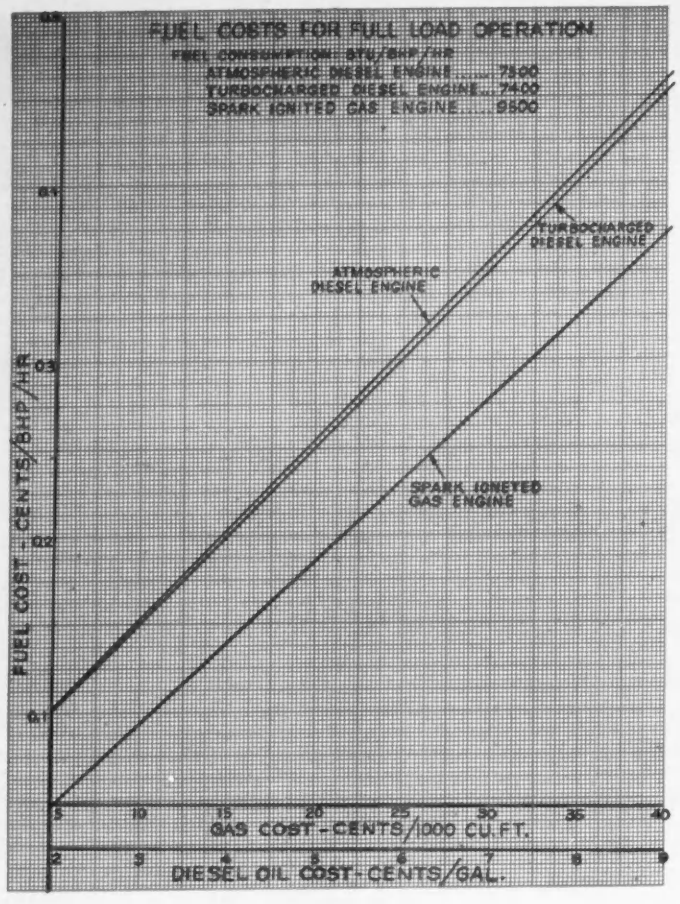
FUEL COSTS FOR FULL LOAD OPERATION
FUEL CONSUMPTION: BTU/BHP/HR
ATMOSPHERIC DIESEL ENGINE 7500
TURBOCHARGED DIESEL ENGINE ... 7400
SPARK IGNITED GAS ENGINE ... 9500
TURBOCHARGED DIESEL ENGINE
ATMOSPHERIC DIESEL ENGINE
SPARK IGNITED GAS ENGINE
FUEL COST - CENTS/BHP/HR
GAS COST - CENTS/1000 CU. FT.
DIESEL OIL COST - CENTS/GAL.

FIGURE 2

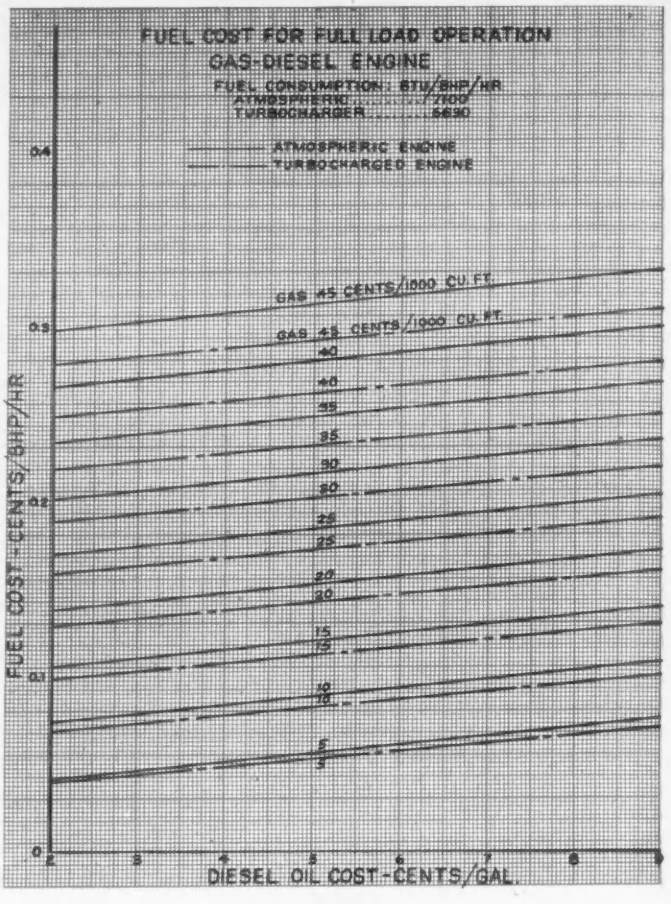

FIGURE 3

From Figure 2, it can be seen that it will cost 0.190 cents per bhp hour for fuel to operate a good spark-ignited gas engine. Also from Figure 2, we find that it will cost 0.360 cents per bhp hour fuel costs to operate a turbocharged diesel engine or 0.365 cents per bhp hour fuel cost to operate an atmospheric diesel engine. From Figure 3, using these same figures of 7 cents per gallon oil and 20 cents per thousand gas, we find that it will cost 0.162 cents bhp hour fuel cost to operate an atmospheric gas-diesel or 0.151 cents per bhp hour fuel cost to operate a turbocharged gas-diesel engine.

Assuming the operation of a 1000 bhp engine for one month the fuel costs compare as follows: Straight gas engine, $1368; atmospheric diesel engine, $2628; turbocharged diesel engine, $2592; atmospheric gas-diesel engine, $1166; turbocharged gas-diesel engine, $1087.

The cost of fuel gas and fuel oil varies so widely that it is impossible to present a comparison for each individual case. The curves are presented to enable the potential user of engines to analyze his own fuel costs from the prevailing market price of the two types of fuel. Of course, in the oil and gas fields the market value of the fuel gas is so low that the diesel engine or the gas-diesel can be considered only in special cases. Also to be considered is the lower heat rejection to the cooling water of the gas-diesel which will reject only 2200 Btu per horsepower hour to the jacket water which means less pumping costs for the life of the station as well as saving in initial investment.

When planning a straight diesel engine for any type of stationary power plant the engineer should investigate the availability of any natural gas which could be used. One of the important advantages of the gas-diesel engine is that it can be switched from 90 percent natural gas and 10 percent fuel oil to 100 percent fuel oil at a moment's notice while the engine is carrying full load. This permits the purchase of gas from the local gas company on a dump load basis and still have a substitute fuel when the gas company is forced to curtail deliveries. A study of the charts show that fuel gas can be purchased for as high as 45 cents per 1000 cubic feet and still result in a substantial saving when operating a gas-diesel engine.

Pipe Line Uses

The pipe line industry offers a good field for the application of the gas-diesel engine. Before this new engine was introduced, practically all prime movers used for crude transmission were oil diesel. This was a perfect application for the diesel engine because in most cases fuel for the station could be obtained directly from the crude being pumped. Now, however, with the price of crude at a comparatively high level, any method whereby its use as fuel for the station system can be curtailed is a move towards greater operating economy.

All crude oil pipe lines originate in oil pools and most lines pass through one or more pools along their route. In most cases natural gas is available in these pools for use as fuel. However, in many instances the supply of natural gas is depleted long before the crude is exhausted. The pipe line industry has always been interested in economic means for utilizing natural gas when available and still avoid replacing engines with prime movers using oil as fuel when the natural gas supply was exhausted. The introduction of the gas-diesel engine permits pipe-liners now to take advantage of all natural gas along the right-of-way and still have instant convertibility to crude or fuel oil should the gas supply fail.

Savings in fuel cost by using the gas-diesel engine are great. For example, if crude being pumped is worth $2.10 per barrel it can be seen from the curves that the pipe line company could afford to pay as much as 35 cents per 1000

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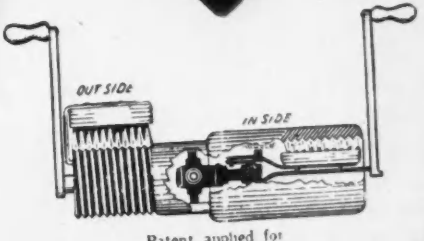
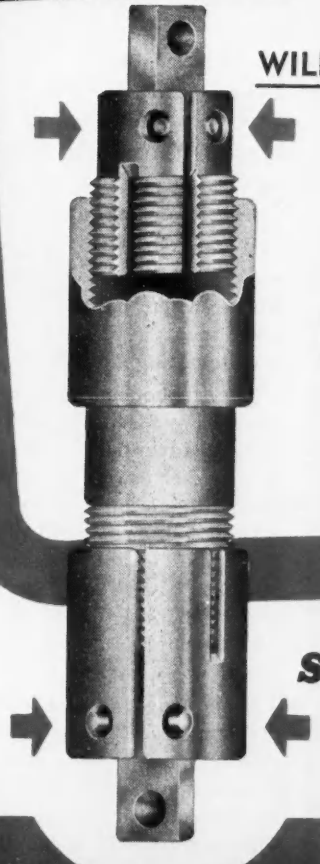


Patent applied for



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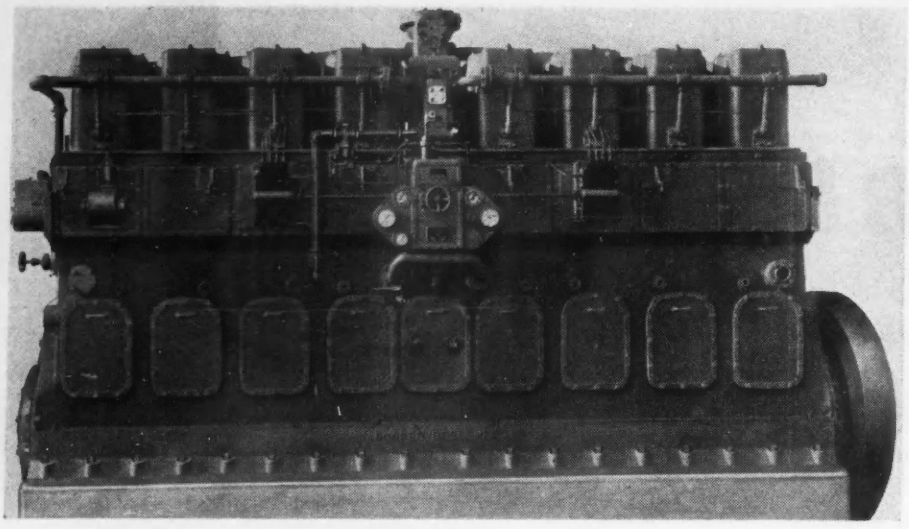


Gas-diesel engine rated 1000 brake horsepower at 300 revolutions per minute.

cubic feet of gas and still show a saving in operation of the gas diesel over the regular oil diesel engine. If gas could be purchased at a figure of 15 cents per 1000 cubic feet, the gas-diesel can be operated at a saving of $1 per horsepower per month.

This saving is quite significant because it is great enough to allow the pipe line company to retire obsolete oil diesel engines and pay for the new engines out of the savings. For example, an 800-horsepower gas-diesel engine will save $48,000 in fuel costs alone in five years. This saving coupled with the lower maintenance on a modern engine will go a long way toward paying for the new installation.

Another application for which the gas-diesel engine is getting close attention is in the gas transmission pipe line field. With the increased demand for gas in the eastern areas of the U. S., the gas transmission companies are being hard pressed to provide continuous service to all customers, especially in the winter months. If they could switch over to fuel oil during the periods of peak demand in the winter, large amounts of gas could be saved, thus allowing them to provide continuous service to customers who would otherwise have to be cut off. The higher efficiency of the gas-diesel becomes of much more interest also for stations on the northern and eastern ends of these transmission lines. By the time the gas has been transported to these areas far from the producing zone its value has increased many times. From the curves, Figures 2 and 3, it can be seen that if the gas has a value of more than 45 cents per 1000 cubic feet it is more economical to operate a gas-diesel engine instead of the straight gas engine.

Another important application for this new engine will be in oil well drilling. The power plant of a high percentage of modern rigs is the internal combustion engine. The selection of the type of engine has always been a compromise on the part of the rig operator. Of necessity the power plant must be as small and compact as possible because of the portable nature of the drilling rig.

The high speed, high output automotive type gasoline engine is ruled out immediately because of the fuel cost and also the comparatively low dependability of this type of power plant. The turbocharged diesel engine is the logical choice to meet this condition. This engine combines extremely good fuel consumption with light weight and compact size. The greatest disadvantage to this engine, however, is its dependability on fuel oil as a fuel source. The fuel oil often must be transported many miles to the drilling site, which is a further disadvantage.

After the discovery of almost any new field the driller finds himself surrounded by an abundance of cheap natural gas. If he is using a straight diesel rig he is compelled to continue using fuel oil for power and is unable to take advantage of the natural gas. This condition has led to the adoption of the gas engine as a drilling rig prime mover. The gas engine does not compare with the turbocharged diesel engine on a power-to-weight ratio basis. In other words, a gas engine to deliver the same horsepower as a turbocharged diesel engine would have to be 60 percent heavier and bulkier than the diesel engine. The driller has had to accept this disadvantage because of the multiple choice of fuels he has with the gas engine. It has become common practice to use natural gas as a fuel when it is available and to use butane or propane as a substitute when natural gas is not available, such as when the rig is engaged in wildcatting operations.

The turbocharged gas-diesel engine has now made it possible for the driller to take advantage of the compact, efficient diesel engine principle without the disadvantage of not being able to use natural gas as a fuel. With this engine the driller is able to save a great deal of space and weight on his rig, which in turn cuts the cost of transportation and assembling the rig on the drilling site.

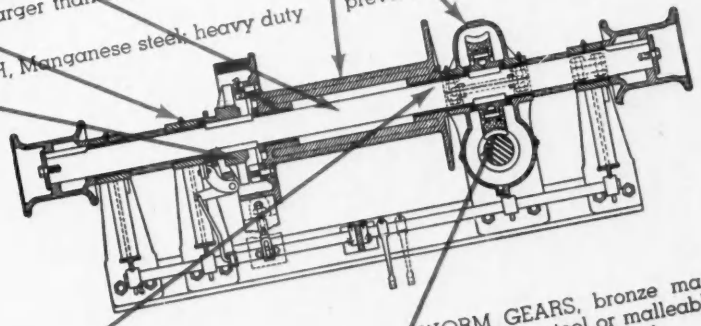
It is true that he must provide 10 percent diesel oil for pilot ignition with this engine. In most cases, however, this disadvantage is overcome by the superior fuel consumption which is inherent with this engine. Of course, the type of rig being designed, its general field of operations and a great many other factors will have to be taken into consideration in the selection of its power plant. However, the gas-diesel engine is certain to come forward as a major source of power in the drilling industry.

About the Author

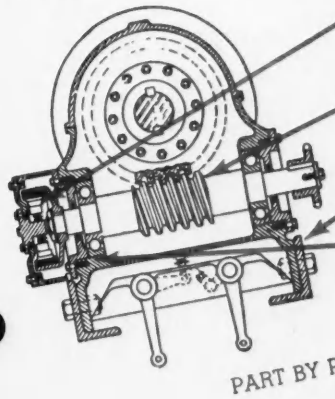
R. A. DARLING has been with the Cooper-Bessemer Corporation since his graduation from Oklahoma A. and M. College in 1940. For the past three years he has been engaged in sales engineering work at the company's Tulsa branch. His background in engineering together with his wide association in the petroleum industry makes him well qualified to write on this subject.

From A Transportation Engineer's Notebook

TULSA WINCHES built for rugged work



- DRUM SHAFTS, alloy steel, heat treated and ground. With end-milled key-ways and alloy steel keys.
- BEARING CAPS removable on all models larger than No. 23.
- CLUTCH, Manganese steel; heavy duty positive type.
- REMOVABLE GEAR COVER on all models makes practically all working parts accessible without removing winch from truck.
- DRUMS, well ribbed and designed to prevent crushing. Large drum bearings.
- DRUM SHAFT BEARINGS removable bronze; bronze gear thrust bearing on all models.
- WORM GEARS, bronze machine cut, mounted on steel or malleable carriers. No adjustment required.



- WORM BRAKE, automatic, adjustable, sealed off from grease.
- WORM, forged steel, heat treated, hardened, ground journals and threads.
- BASE, wide, well designed to prevent pulling off truck.
- WORM SHAFT BEARINGS, heavy duty, deep groove ball bearings.

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Checking Tulsa Winches part by part, you'll find them more exactingly engineered and better constructed, built from materials selected for necessary strength and durability. Listed are the eleven most important parts of any truck winch. Be sure to check these parts for materials and workmanship before buying. Tulsa Winch distributors in leading cities.

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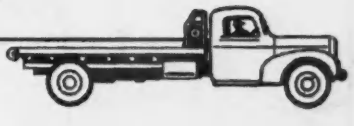
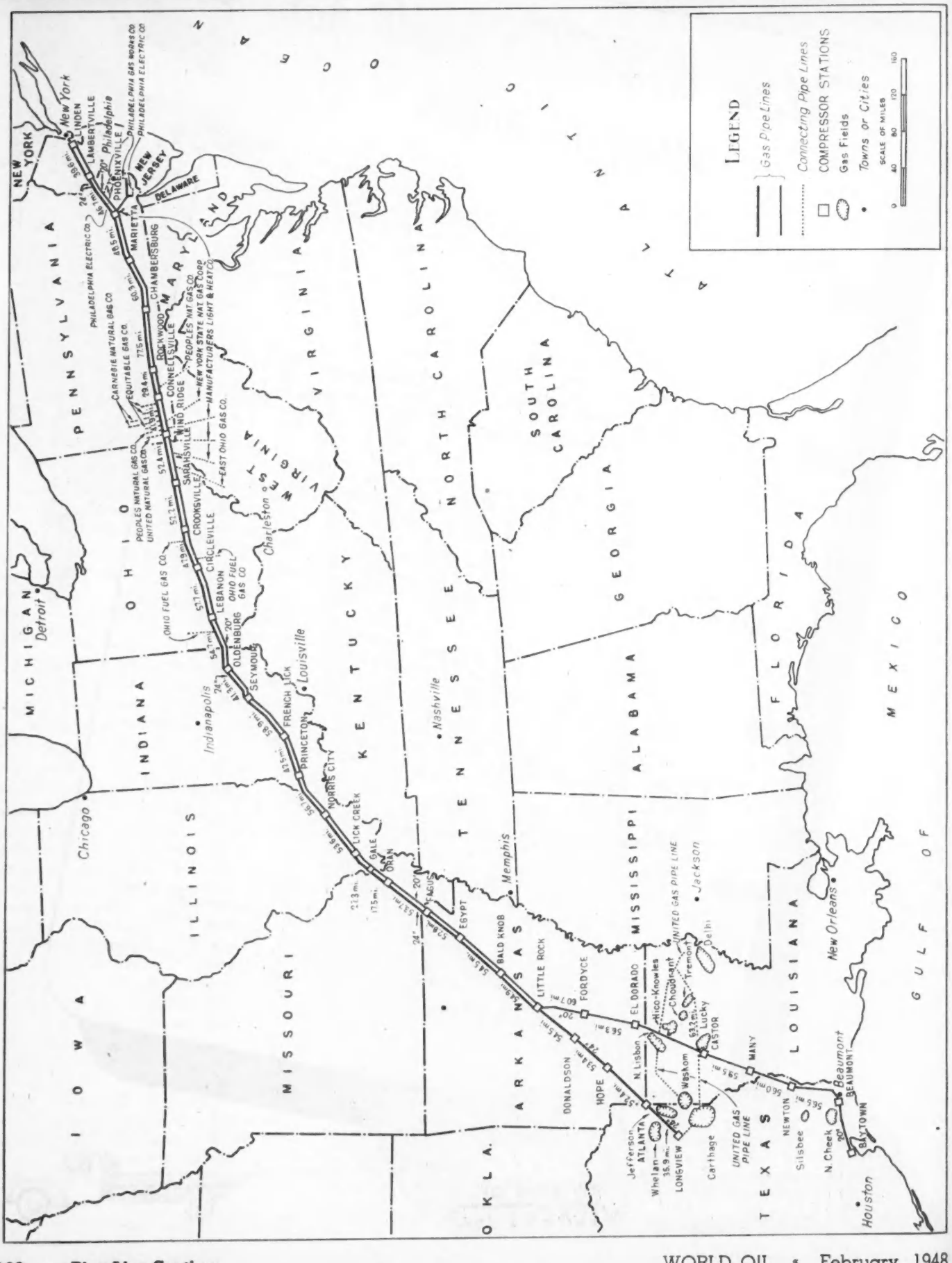
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.



Pipe Lines of the U. S.

Texas Eastern Transmission Corporation

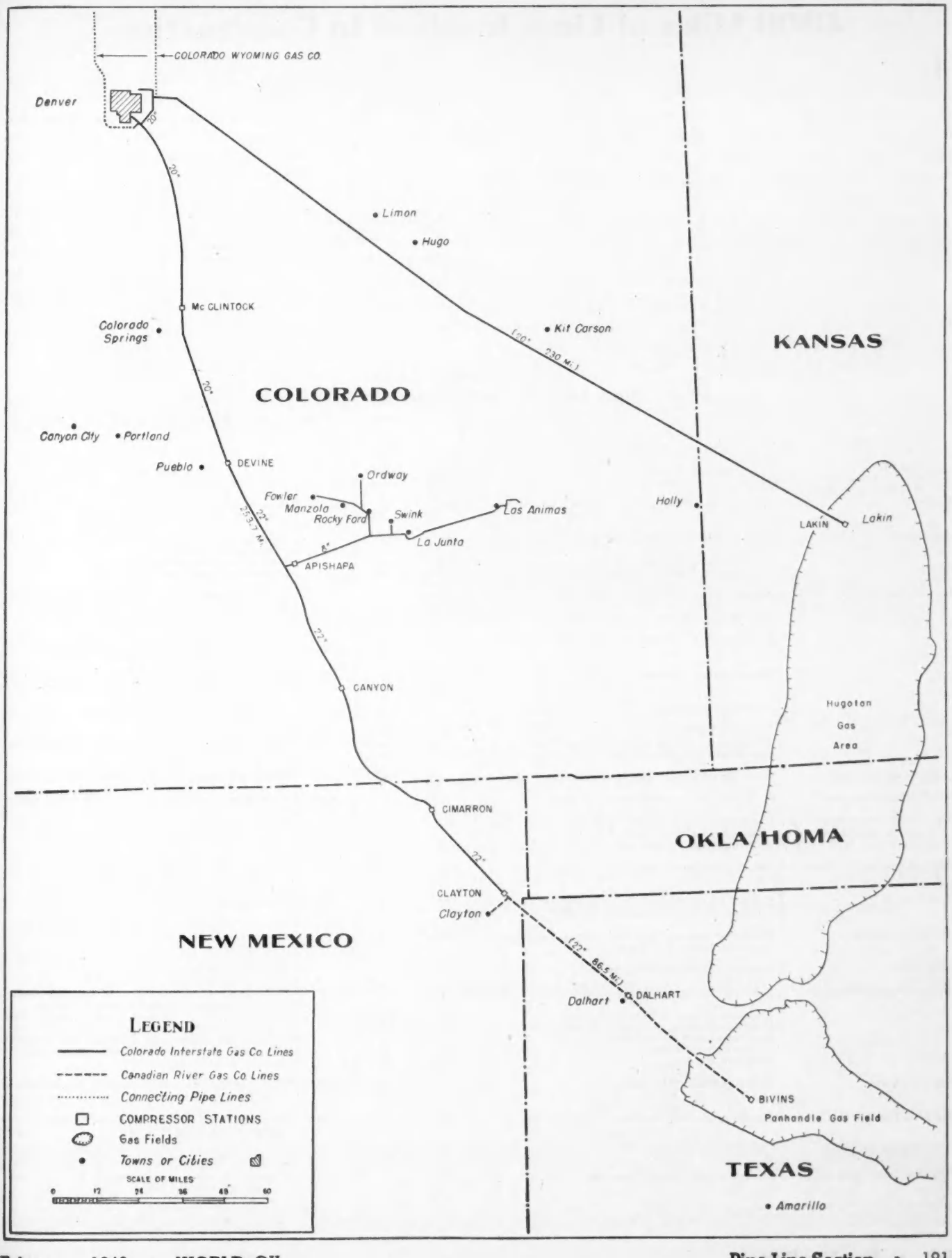
43rd of a Series



Pipe Lines of the U. S.

Colorado Interstate Gas Company and Canadian River Gas Company

44th of a Series



PIPE LINE *Construction*

4800 Miles of Lines Involved In Construction

THE trite but true reasons of delayed pipe deliveries and winter weather explained slow progress on many projects in the past month, but a number of proposed lines increased the total of miles involved in pipe line construction reports to approximately 4800.

Some of the more important activity concerned products lines. Sinclair Refining Company, now laying a ten-inch line from Houston to Fort Worth-Dallas, with laterals to Austin, San Antonio and Corpus Christi, completed plans to extend the system into Oklahoma. Further extension via Kansas City to Columbus, Ohio, was still postponed. There are now three products lines being carried from the Coast to the North Texas area: a Humble line is already in operation, and Magnolia-Texas Pipe Line Company's joint line is about half complete.

The big crude lines under construction made steady progress. Magnolia Pipe Line Company's 647-mile 20-inch line from Corsicana, Texas, to Patoka, Ill., is about two-thirds complete and being filled with oil as sections are completed. It is expected to be completed in the spring. Gulf Refining Company, Pipe Line division, is looping its West Texas-Port Arthur line, and Stanolind Pipe Line Company its Drumright to Slaughter line. Stanolind plans to extend the loops later in 1948, increasing the system's capacity from 83,000 barrels per day to 132,000 barrels. A new company, Arizona Pipe Line Company, was said to be planning a line from the Permian Basin to Phoenix, Ariz., to a refinery to be constructed there. Mid-Way Pipe Line Company was reported to be considering a 600-mile line from the Permian Basin to Oklahoma and Kansas.

Pipe Line Construction Activity

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size, (Inches)	Daily Capacity (Bbls., Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Arizona Pipe Line Co.	Permian Basin to Phoenix, Ariz., refinery (proposed)	620	8	14,000	Plans being considered. Pipe line not to be laid until completion of refinery, possibly 1951.
Gulf Refining Co., Houston Pipe Line Division	From Lucas, to Port Arthur refinery, Texas Gulf Coast	11	10	.....	Construction being completed by Latex Construction Co. Houston, late January.
	Alameda to Raewood loop, Gulf Coast	14	8	.....	Latex to start construction February 15.
	From Jordan-Ellenburger field to transmission line	3	4	.....	Construction to start soon.
Humble Pipe Line Co.	Navarro Crossing to Long Lake, Gulf Coast	22 7/10	4	.....	Line being taken up by Smith Contracting Co., Ft. Worth
		15 7/10	4	.....	Relaid by Smith Contracting Co. Work completed.
	Ector Station to Judkins station, West Texas	10 5/8	8	.....	Construction completed by J. J. Willis, Odessa, Texas.
	Dollarhide field to Dublin station on Hobbs-Winkler line	10 1/2	8	.....	Completing late January by Morrison Bros. Construction Co., Odessa.
	Satsuma station to Webster, Texas Gulf Coast	5 9/10	6	.....	Lines being taken up and reconditioned by Latex Construction Co., Houston. Scheduled completion date in March.
		39 9/10	8	.....	
		25 7/10	12	.....	
	Webster to Texas City	3 1/2	6	.....	
		7	8	.....	
	Webster to Baytown	23	8	.....	
	Thompsonville to Bruni station, Southwest Texas	15 1/2	6	.....	Shanks & Eustace, Alice, Texas, completing reconditioning job in January.
	Benavides to Agua Dulce station	1	8	.....	
Interstate Oil Pipe Line Co.	Katie-Maysville area, Garvin County, to Oklahoma City line	44 1/2	12	.....	Midwestern Constructors, Tulsa, completing in January.
Mid-Continent Pipe Line Co.	S. Canadian River to Fitts Station, Oklahoma	17	4	6,600	A. C. Holder Construction Co., Tulsa, awarded contract for loop.
S.A. Petrolera Las Mercedes (Texas Co. and Caracas Pet. Co.)	Guasimito station, 5 mi from Las Mercedes field to Pamatacual terminal near Guanta, Venezuela	157	16	.....	Williams Bros., Tulsa, has started construction. Completion scheduled May, 1948.
	Gathering system for field	10	6	.....	
Salt Lake Pipe Line Co. (Standard of Calif.)	Rangely field, Colo., to Salt Lake City, Utah	160	10	25,000	Contract for three spreads to be awarded in March. Estimated cost of project $5 mln.
Shell Group	El Dificil field to Plato station on Andean Pipe Line Co.'s Barrancabermeja-Mamonal line, Colombia	48	6	3,000	Project planned for 1948.
Shell Pipe Line Corp.	Ellenburger discovery, P. B. Scott Survey, Upton County to Upton station, West Texas	10	8	.....	Construction by Morrison Brothers Contractors. Odessa, Texas.
Skelly Oil Co.	Extension to Velma gathering system	9	6	.....	Contract not awarded.
Stanolind Pipe Line Company	Gathering system in Levelland field, Hockley County, West Texas	10	6	.....	C. L. Rogers Construction Co., Wichita Falls, Texas awarded contract, to complete work in February.
		16	4	.....	
	Loops from Monroe to Post, North Texas	49	8	.....	R. H. Fulton & Co., Lubbock, Texas completed. Work under way on second loop., to be completed in April.
	Monroe to Floydada, on Slaughter-Drumright line	46	16	.....	
	Loops from Bretch station, Oklahoma	5	16	.....	Company awarding contracts in January, to be completed in March. All 4 loops to be extended during summer.
	El Reno station, Oklahoma	14	16	.....	
	Drumright, Oklahoma	15 1/2	16	.....	
Sunray Oil Corp.	Beckett to Velma, Oklahoma	17	8	20,000	Work to be completed January, 1948, by Pipe Line Service Co., Seminole, Oklahoma.
The Texas Pipe Line Co.	Houston to Port Neches refinery, Texas Gulf Coast	80	22	160,000	Postponed during 1947 for lack of pipe; expected to construct in late Spring or Summer.
PRODUCT LINES					
Colombian Government	Pto. Berrio to Pto. Salgar, Colombia	88	6	.....	Proposed; to extend Barrancabermeja-Berrio line completed late December, 1947.

• TABLE CONTINUED ON PAGE 184

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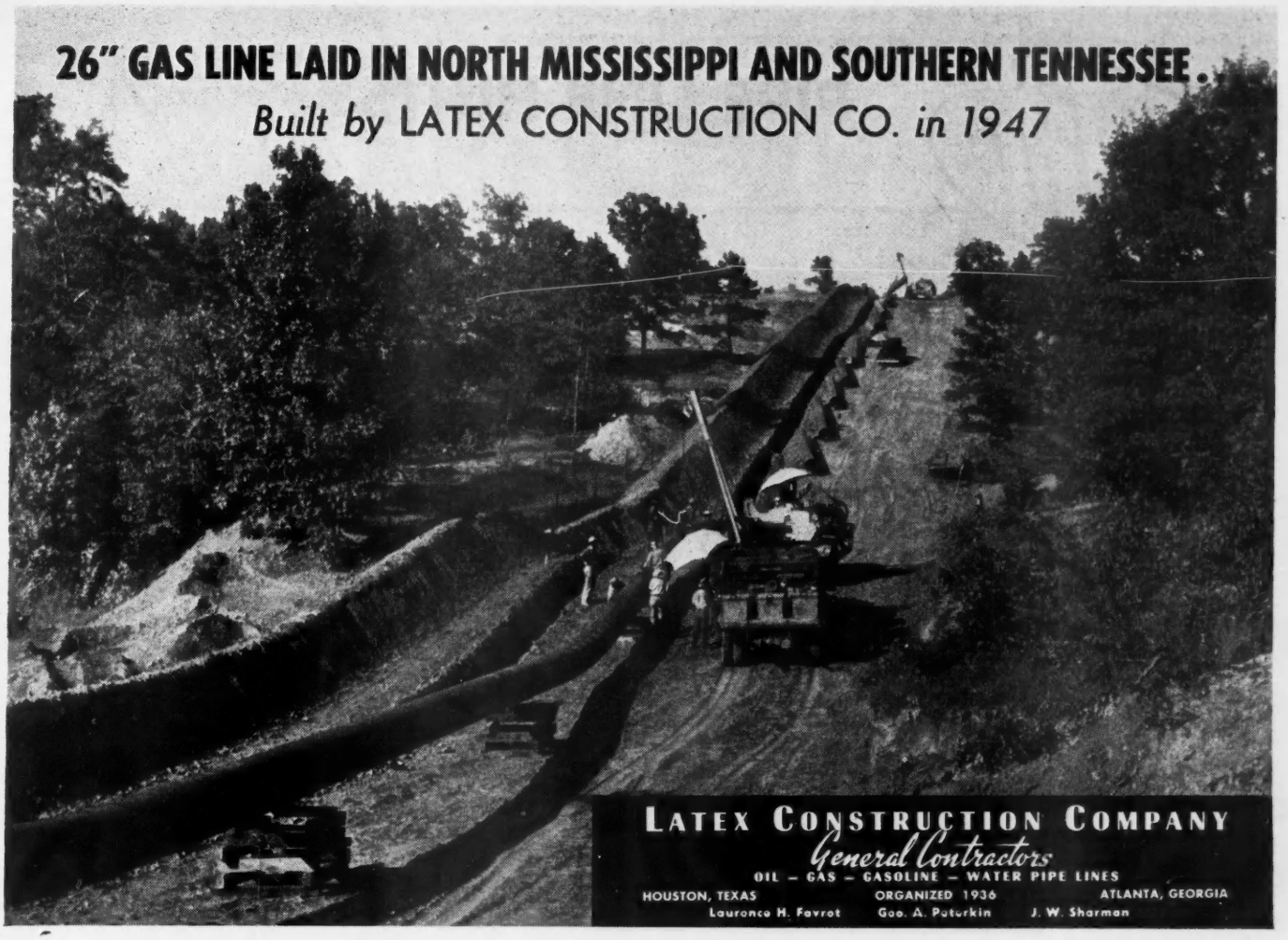
INTERNATIONAL *Trucks*

Pipe Line Construction Activity (Continued)

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size, (Inches)	Daily Capacity (Bbls., Cu. Ft.)	REMARKS
Caldas (Colombia) Government	Pto. Salgar to Manizales, Colombia	56	6	.....	Proposed extension by State Government into industrial area.
Phillips Petroleum Co.	Borger to McKee, North Texas	37	6	.....	Albert Johnson Construction Co., Oklahoma City, completing spread. Line carried from Borger to La Junta, Colo., Will finish 152-mile spread to Denver in 1948 if pipe can be obtained.
	Loops on Borger-Chicago line. Near Cheney, Kansas	8	8	.....	Loops being completed in 1948 in order named.
	Near Laverne, Oklahoma	9 9/10	8		
	Near Medicine Lodge, Kansas	7 1/4	8		
	Near Buffalo, Oklahoma	8 1/2	8		
	Hardtner, Kansas	8 1/10	8		
Sinclair Refining Co.	Dallas-Ft. Worth terminal to Panova station near Shawnee, Oklahoma	185	8	.....	Contractor not known. Plans still indefinite to continue system north to Columbus, Ohio.
Stanolind Oil & Gas Co.	Gathering system near Sundown, Texas	320	30-2	.....	Deaton & Sons, Odessa, Texas, to start construction April 1.
NATURAL GAS LINES					
Anchor-Hocking Glass Corp.	Winchester, Ind., to Ripley, W. Virginia	7	6	.....	Take-up job.
		10	6	.....	Midwestern Constructors, Inc., Tulsa, started job in January.
Atlantic Seaboard Corp. and Virginia Gas Transmission Corp.	United Gas's Cobb station, near Glendenin, W. Virginia, to Rockville, Maryland	268	26	.....	Application filed with FPC, work to start in 1948 if pipe available.
Cities Service Gas Co.	Gathering system near Guymon, Texas County, Oklahoma	7	20	.....	Carlson & Son Construction Co., Pampa, Texas, have work under way.
		12	12	.....	
		10	10-54	.....	
Colorado Interstate Gas Co.	Hugoton area, Grant County, Kansas	25	16-4	.....	J. E. Cheek Construction Co., Pampa, Texas, to complete extensions to gathering system in April.
East Ohio Gas Co.	Mullet Farm to Ross Farm stations, Ohio	84	20	.....	FPC granted authority; construction to start in February
East Tennessee Nat. Gas Co.	TGT line near Nashville to Chattanooga, Tennessee	186	16	.....	Authorized by FPC. Contract awarded to N. A. Saigh Co., San Antonio, Texas.
	Chattanooga to Knoxville, Tennessee	112	12	.....	
	Gathering lines and laterals	150	8-4-3	.....	
El Paso Natural Gas Co.	From 26-inch main line to Tucson City Gate Station 2, Ariz.	5	4 1/2	.....	Construction to start early in February, Company crew.
	From 26-inch line to Phoenix, Arizona	20	8	.....	Construction to start early in February. Company crew
	Eunice, N. M., to Dumas, Texas	251	24	.....	Construction to start April 1. Company crew.
Goodman & Co.	Near Clarksburg, W. Virginia	8	6 & 8	.....	Take-up job to be completed by Midwestern Constructors, Tulsa, February 1.
Kansas-Nebraska Natural Gas Co.	Elm Creek, Nebraska	35	.....	.....	Application to FPC to construct facilities costing estimated $3,130,865. Replacement of existing line with larger diameter pipe involved.
	Scott City-Phillipsburg and Otis Plainsville lines looped	.....	.....	.....	
Magnolia Pipe Line Co.	Gathering system in Hugoton, Kansas, area	170	24-4	.....	Contract awarded to R. H. Fulton & Co., Lubbock, Texas
Maljamar Repressuring Agreement Association	Maljamar, New Mexico	15	.....	.....	Project completed by McVean & Roberts, Odessa, Texas in January.
McCarthy Oil & Gas Corp.	Jackson Pasture to Winnie plant, Texas Gulf Coast	22	12 3/4	100 mln	Construction started by Anderson Bros. Corp., Houston on February 1.
		23	14		
	Winnie to Orange, Texas Gulf Coast	20	16		
		10	20		
Mississippi River Fuel Corp.	Loops in Louisiana and Arkansas	172	22	.....	Completed by Holland Construction Co., Tulsa. Company worked on project throughout 1947.
	Loops between Perryville, Louisiana, and St. Louis, Mo.	199	22	.....	Authorized by FPC. Contract awarded to R. B. Potashnick.
		20	10		
Northwestern Utilities, Ltd.	Loop on Kinsella field to Edmonton line, Alberta, Canada	19 3/4	16	.....	Work completed in December.
Ohio Fuel Gas Co.	Near Lorraine, Ohio	1	8-6-4	.....	Midwestern Constructors, Inc., Tulsa, completing both lines in January.
	Near Parma, Ohio	2 1/2	10	.....	
	From Brown station to Monroe and Pavonia stations, Ohio	22	16	.....	FPC-approved application involves removal of some 39 1/2 miles of smaller lines.
Oklahoma Natural Gas Co.	Witcher field to Harrah plant, Oklahoma	14	8	.....	Western States Construction Co., Dallas, has started construction.
Pacific Gas & Electric Co.	Rosedale-Greeley field, San Joaquin Valley, California	2 3/4	20	.....	Completed by Pacific Pipe Line & Engineers, Ltd., Los Angeles.
		3	16	.....	
Peoples Natural Gas Co.	Dice storage field, Westmoreland County, to Wilkinsburg station, Pa.	10	12	.....	Pipeline Construction Corp., Camp Hill, Pa., completing in February.
Rocky Mountain Gas Co.	Rawlins to Medicine Bow, Wyoming	54	9	10 mln	Dawson & Corbett, Rawlins, Wyo., have half completed construction, but pipe shortage expected to delay final completion.
Rio Grande Valley Gas Co.	Loop on San Salvador to San Benito, Southwest Texas	43 1/2	10	.....	Construction completed.
Southern Natural Gas Co.	Main line loops	18 1/2	20 & 22	.....	Temporary authority on first 3 loops granted June, 1947, confirmed by FPC. Other loops part of 1947-48 program also granted. Other facilities, including main-line connection to Tallassee, Ala., and laterals and compressors to cost estimated $12,296,610.
	Loop on Meridian, Mississippi, line	9	6		
	Loop on the Columbus-West Point, Mississippi, line	6 1/2	6		
	Main line loops	130	24 & 20		
	Loop on branch line to Gadsden, Alabama	33	12		
Tennessee Gas Transmission Co.	Carthage gas field, East Texas, to Natchitoches, Louisiana	73	20	.....	Latex Construction Co., Houston, expects to complete February 1.
The Texas Production Co.	Lake Salvador and Delta Farms fields to Lafitte plant, La.	17	8	.....	Associated Contractors & Engineers, Houston, to complete line in February.
United Gas Pipe Line Co.	Alexandria to Foster, Kentucky	23	24	.....	Williams Bros., Tulsa, scheduled to complete line in February.
	West Lake Verret field to Oaklawn Plantation, St. Martin Parish, Louisiana	4 3/8	7	.....	Brown & Root, Inc., Houston, scheduled to complete in February.
		9	8		
Warren Petroleum Co.	Gathering system in Garvin-McCain County, Oklahoma	200	30-2	.....	Contracts not awarded yet on natural gas and products system to serve new Maysville gasoline plant, now under construction.


26" GAS LINE LAID IN NORTH MISSISSIPPI AND SOUTHERN TENNESSEE.
Built by LATEX CONSTRUCTION CO. in 1947
LATEX CONSTRUCTION COMPANY
General Contractors
OIL – GAS – GASOLINE – WATER PIPE LINES
HOUSTON, TEXAS
ORGANIZED 1936
ATLANTA, GEORGIA
Laurence H. Favrot
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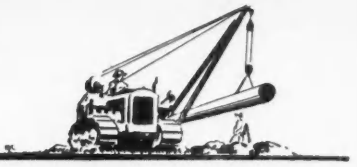
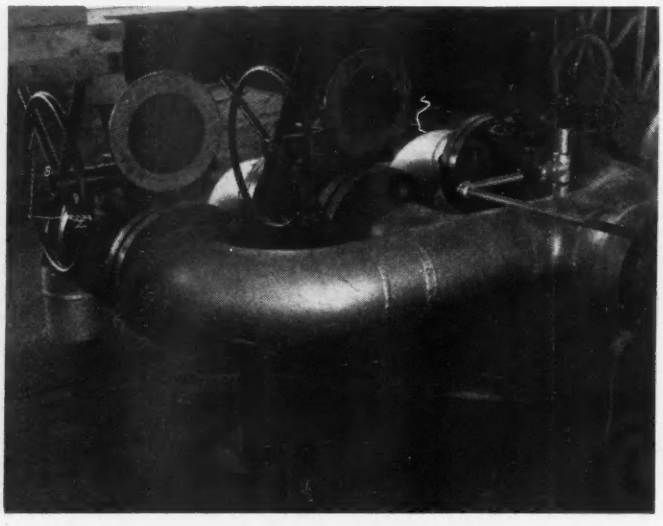


$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

How To—Provide Positive Seal Against LPG Seepage



Pumping, loading unloading, and storing butane, propane, and natural gasoline, commonly referred to as LPG or liquified petroleum gas, presents a serious problem to the pipeliner. These petroleum products are not only difficult to store, but even more so, are difficult to transfer from one place to another. One of their less desirable characteristics of the lighter products, particularly propane and butane, is their ability to seep around the tightest sealed valve, without regard to type or make. Plug-type valves have been found to hold these highly volatile substances more satisfactorily than other types, but after extended service, the light liquids seem to find their way around the tight seal of the plug.

Manifolds handling a variety of these light products are now designed to accommodate a blank to be placed upstream of the valve so that these difficult liquids are positively sealed off. However, when the blank is removed, and the flange is drawn up tight, undue stress is placed on the manifold since the space formerly required by the flange blank has been taken up by the flange bolts.

The construction superintendent of one pumping station designed a valve blanking device which is called a "spectacle blind" since it resembles the shape of eye glasses. It consists of two circular plates of steel, (diameter and thickness vary with applications) joined by a short piece of strap steel. The center of one plate is cut out so that the inside diameter is nearly that of the flange throat in which it is held.

When in service, one plate will project upward so that the station operator can easily tell at a glance whether the valve is blanked off or open. When the line is to be opened, the open plate is used and takes up exactly the same space required by the closed plate with the result that no undue strain is placed on the manifold.

How To—Increase Value of Pipe Line Maintenance Trailer

Adding to the usefulness of a small two-wheeled utility trailer designed by the maintenance department of one company is the collapsible stand and pipe vise base which are attached to the tongue of the trailer. A steel pad welded to the upper side of the tongue provides the base for the small vise, the latter capable of holding work of moderate size, including assemblies of pipe fittings of the type illustrated necessary in the laying of small pipe lines or minor repair jobs.

A telescoping roller stand, part of the pipe fitting equipment, complements the vise and permits the handling of unusually long assemblies considering the size of the trailer. The trailer tongue stand is adjustable, being provided with a quadrant which permits it to be locked in several positions between vertical and horizontal, the latter being in a fully-collapsed position when the unit is moved between locations.

Other features mounted on the front end of the trailer include drinking water can and cup dispenser, a cylindrical container for carrying cleaning fluid and a large bucket in which tools and fittings can be washed. Fully equipped, the trailer has the majority of the features ordinarily found on the average maintenance truck, but with the added advantage that the truck normally tied up on one particular job, now can be taken away for duty on other work without interfering with efficiency of the workmen on the initial job.

SUPERIOR ABRASION RESISTANCE

Parts made from HYCAR synthetic rubber have 50% greater abrasion resistance than parts made from natural rubber. That means they'll last longer, give more dependable performance in the most severe service, and save maintenance and replacement time.

But that's only one of HYCAR's unusual and valuable properties. Examine the list in the box at the right. Think of these properties in terms of your requirements of rubber parts. Realize that these properties may be had in an almost limitless number of combinations, each designed to meet the specific service conditions of the finished part.

We have developed more than 5000 recipes for HYCAR compounds — each compound engineered to do a certain job. If you're looking for rubber parts that will give long life, dependability, and economical operation, *specify HYCAR.*

Ask your supplier for parts made from HYCAR. Test them in your own applications, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Department HP-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

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2. *Resists action of abrasive-laden fluid under high pressure and at high velocity.*
3. *Wears at slow rate even under worst conditions.*
4. *Makes a positive, leak-proof seal, even after a long period of service.*
5. *Provides high elasticity.*
6. *Gives high tensile strength*
7. *Has minimum tendency to cold flow and compression set.*

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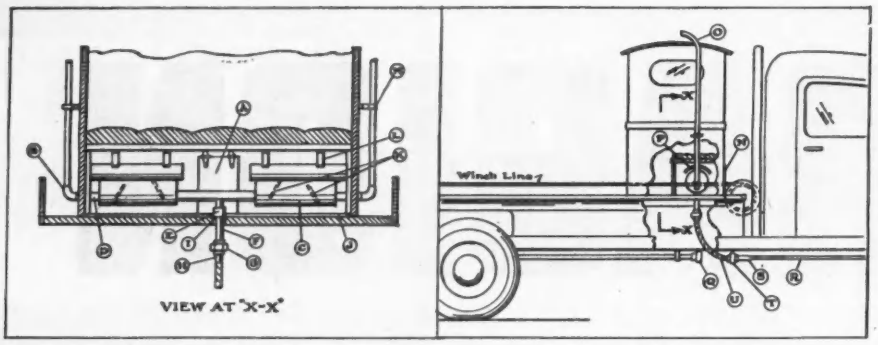
How To—Heat Four-Man Cab with Truck Engine Exhaust Gases



During winter months, some form of heating in the field truck cab is most welcomed by pipe line crews who must travel some distance from the station to make line repairs. Proven in more than a year's service is a heater designed by one pipe line foreman who utilized heat from the engine exhaust gas to maintain a comfortable temperature inside a small closed four-man cab mounted on the bed of a truck as shown.

Two mufflers were made from 16-gauge rolled steel, and placed beneath the seats provided in the cab. These mufflers were then joined with a short nipple of two-inch pipe containing a tee connection at its center to accept a second nipple which is inserted through the cab floor.

The exhaust pipe, normally furnished with the truck, is cut and a short section removed, each end being fitted with unions. Both ends of a piece of two-inch flexible tubing are brazed to the male sections of two unions, one end being screwed to the exhaust pipe under the truck, while the other end being connected to the tee coming from the two mufflers in the cab.

The outboard end of each muffler is fitted with a short nipple and an ell connected to a riser extending above the top of the cab. These two outlets permit the exhaust gases to escape into the atmosphere. When in operation, the engine generates sufficient heat to maintain comfortable temperatures inside the cab even when extremely cold temperatures exist outside.

During the summer months when it is undesirable to heat the cab, the flexible tubing is disconnected from the exhaust pipe and a short nipple containing matching unions is screwed back into the pipe to conduct the exhaust gases to the rear of the truck in the normal manner. This device is relatively simple to construct and is somewhat less expensive than kerosene heaters. They require no maintenance and are quite safe.

How To—Collect Condensate and Moisture in Gas Transmission Mains

A long gas transmission line acts somewhat like a condenser in the formation of condensates due to pressure-temperature changes along the line. When excessive quantities of these condensates accumulate in the line, not only will the line friction increase, but the danger of getting slugs of fluid into the booster pumps and associated equipment is also greater. There are many types of drip collectors installed on a gas transmission line, and each is different in detail. Illustrated is still a different application of a drip collector wherein the topography has been used to advantage.

The drip collectors on each of the pipe lines shown are similar in construction and use. They are of the same diameter as the gas line and are located in a low point in the transmission system. Advantage was taken of a gulley where the mains were exposed for approximately 75 feet. A collar was welded at a low point in each line and connection made into the drip collector. The pressure inside these vessels is equalized with the line pressure, thus allowing the liquids to flow inside the collectors.

Each section of pipe forming the drip collector is about 30 feet in length and supported by a simple sling made from bar steel. A pipe saddle of strap steel provided with "ear" pieces through which the rod passes carries the weight of the collectors.

Pressure inside the suspended vessels provides the necessary force to remove the liquids to a tank where the condensate is stored. These collectors are of all-welded construction and their open location make inspection and repairs a simple matter for line walkers and maintenance crews.

- **Best for On-the-Job Performance**
- **Best for Day-after-Day Reliability**
- **Best for Ease of Maintenance**
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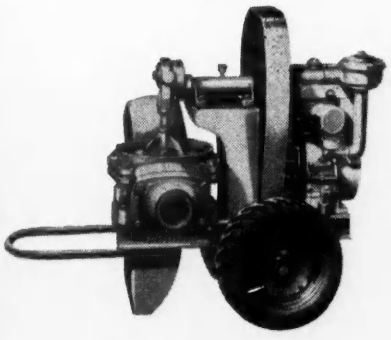

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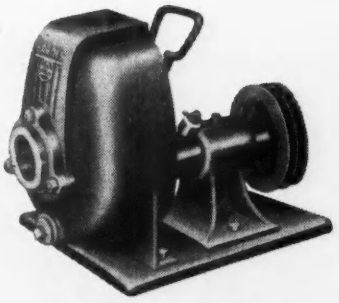

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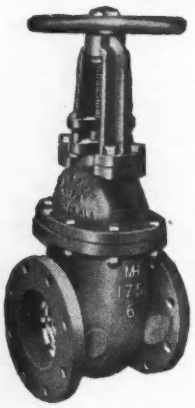
VALVES, HYDRANTS
And Pipe Line Accessories



M & H valves are used in the oil industry for water, gas, steam, oil, chemicals and are furnished in all commercial sizes from 2" to 30", inclusive. They are cast iron body, bronze mounted, furnished double disc parallel seat or solid wedge. They are heavily proportioned and have a high factor of safety.

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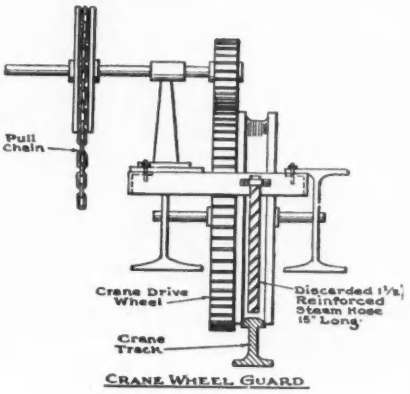
M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

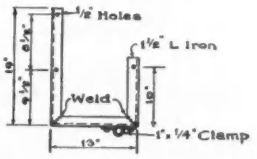
How To— Add Safety Guards to Overhead Crane

Where overhead cranes are installed in compressor and booster stations to make repairs on heavy equipment, a simply-constructed guard for the crane wheels will do much to avoid mashed fingers and toes of personnel working around the crane tracks.

The guard is installed on each end of the moveable crane, four such guards being provided. Each guard is placed in such a position that it will push anything that may be on the track when the crane is moved in either direction. The hose, extending close to the track as shown in the accompanying diagram, is located so that if anyone's foot or hand is on the track, when the crane is being moved, they will have a warning, thus saving their hand or foot from the possibility of being crushed. The flexible hose will not injure the hand or foot, and it does not interfere with the full stop position of the crane at either end of its full travel on the tracks.



CRANE WHEEL GUARD



DETAIL OF GUARD

Four brackets are made of 1½-inch by 3/16-inch angle iron to fit the ends of each wheel section. These brackets are bolted to the I-beam frames that support the travelling beam. The hose is then bolted to these brackets so that each hose almost touches the track. Discarded reinforced steam hose or any stiff hose will suffice. In order to reinforce the hose, a round wooden stick is inserted in the end where a clamp is used. The hose is adjustable and should clear the track by ½ inch.

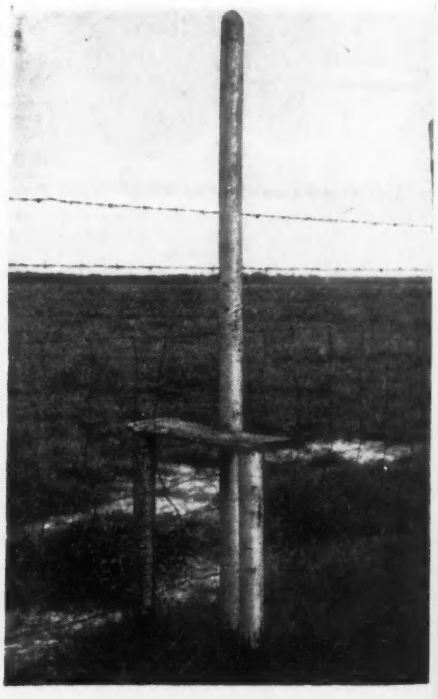
How To— Erect Simple Fence Crossing

One pipe line company speeds up the job for its line walkers by equipping all fences with a simplified stile so that the barrier, even when provided with barbed strands for its top wires, can be crossed quickly and safely.

The crossing consists of three sections of 2-inch pipe, two of them each three feet in length, the other long enough to be driven 18 inches into the ground and extend about 18 inches above the top wire.

To install, the three pieces of pipe are driven into the ground, according to a pattern. When the short pieces are down to the proper depth, a flat step is welded across them and to the tall pipe. The three pipes are thus joined, affording rigidity to the tall pipe so that it may be used as handhold by the walker when stepping across the fence.

The step plate may be made from nonskid steel flooring, or from tank plate, the latter protected against slippery surface by bridges or beads of welding rod.



What happens when the "push-overs" start pushing back?

ASK ANY GOOD SALESMAN, and he'll tell you that the lush days are just about gone—along with shortages, slow production and the sellers' market.

Today, customers are playing hard to get. The "push-overs" are beginning to push back. Production isn't lagging any more—it's already nearly double the pre-war level, and fast catching up with demand. There's plenty of healthy competition in sight. And you can be glad there is.

American business has always thrived on competition. It still can. But the machinery of selling and distribution will have to work at peak efficiency.

And that means—*more mechanization!*

Mechanization is simply the application of assembly-line methods to the *manufacture of a sale.* It's the only way to balance mass production.

With mechanized selling, you won't turn prospects into "push-overs," but you'll certainly get them leaning your way. By exploring the field, arousing interest, creating a preference for the things your company makes, mechanized selling multiplies the productive capacity of your sales force by the hundreds, or thousands, or by any number your market requires.

But this machine is no stranger to *you.* You know it by its first name—ADVERTISING.

We'd just like to point out that now is the time to put the machine to work, more consistently, more aggressively than ever. And remember that when your advertising goes to work in the right business papers, with their tremendous concentration of handpicked readers, it becomes *the most efficient machine* you can use for manufacturing sales at a profit.

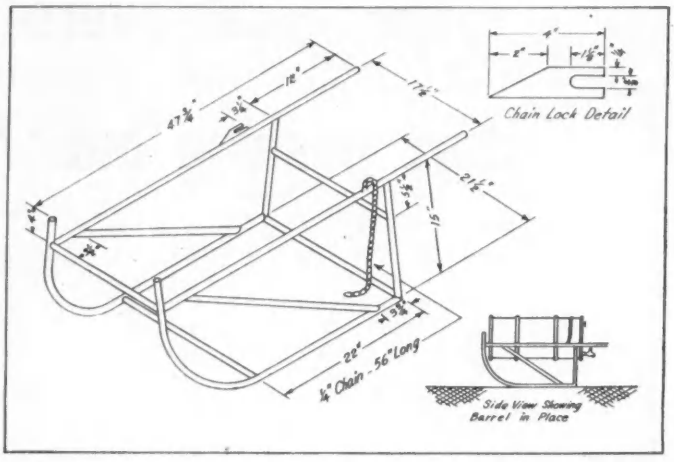
Just how efficiently does business paper advertising work? If you'd like to see some examples, we'll be glad to send you a recent ABP folder on actual results.

WORLD OIL

Specialized for the Drilling, Producing and Pipe Line Industry, is one of the 129 members of The Associated Business Papers, whose chief purpose is to maintain the highest standards of editorial helpfulness—for the benefit of reader and advertiser alike.

How To—Design and Construct an Efficient One-Man Barrel Rack

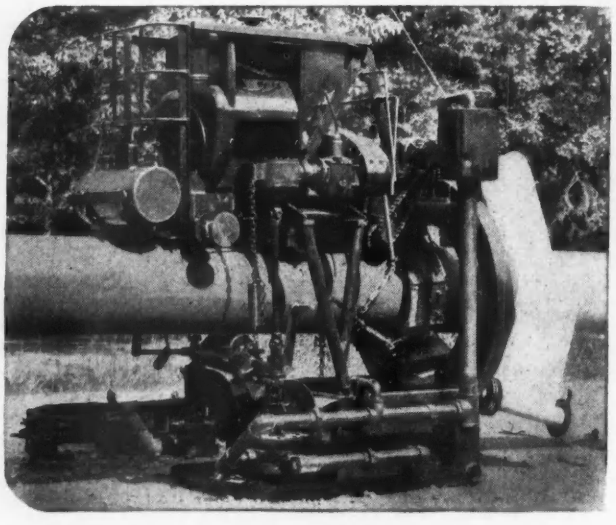
Handling and dispensing lubricating oil, chemicals, gasoline, etc., contained and shipped in large metal drums is normally a task that requires two men, especially if the drum is nearly full. By constructing an efficient barrel rack as illustrated of one inch pipe or comparable size sucker rod material, the job of handling such drums can be materially lessened and only one man is required.



The rack, as shown with dimensions designed to fit the standard metal drum, is simple and inexpensive to make, affording a considerable measure of safety and convenience. One man can install a drain cock in the barrel bung while the drum is in the upright position, and then attach the rack to the drum by securing the chain. With the leverage provided by the rack, he can then lower the drum into a horizontal position with less effort. The rack is of all-welded construction, and provides a skid upon which the drum may be dragged about the warehouse or compressor station. Legs of the rack are towed slightly outward at the bottom to form a sturdy mounting for the drum, and the chain and toe pieces hold the drum in position while lowering or raising. Sufficient details are shown in the diagram to permit any welder to build the rack in short order.

WISCONSIN Air-Cooled ENGINE

Wraps Pipe Line



To protect pipe lines against corrosion, this ingenious machine, powered by a Model VP-4 Wisconsin Air-Cooled Power Unit, wraps pipe in asbestos or glass paper.

Pipe line contractors have found that Wisconsin Engines are best suited for this important operation because of their heavy-duty dependability, low weight and the elimination of "work Holidays" that might otherwise develop from leaky radiators or other cooling and operating hazards. You can depend on Wisconsin Engines for "Most H.P. Hours" of on-the-job service, on any power application within a 2 to 30 hp. range.

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510 Atlas Building, Tulsa, Oklahoma
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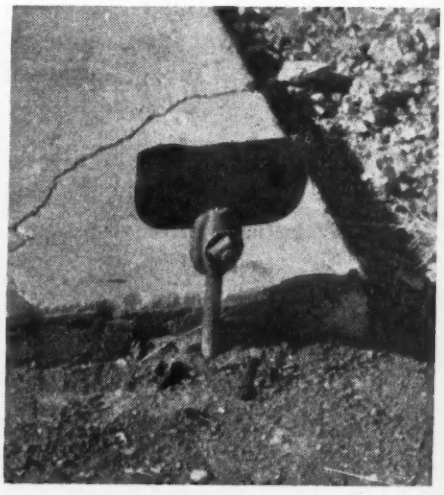
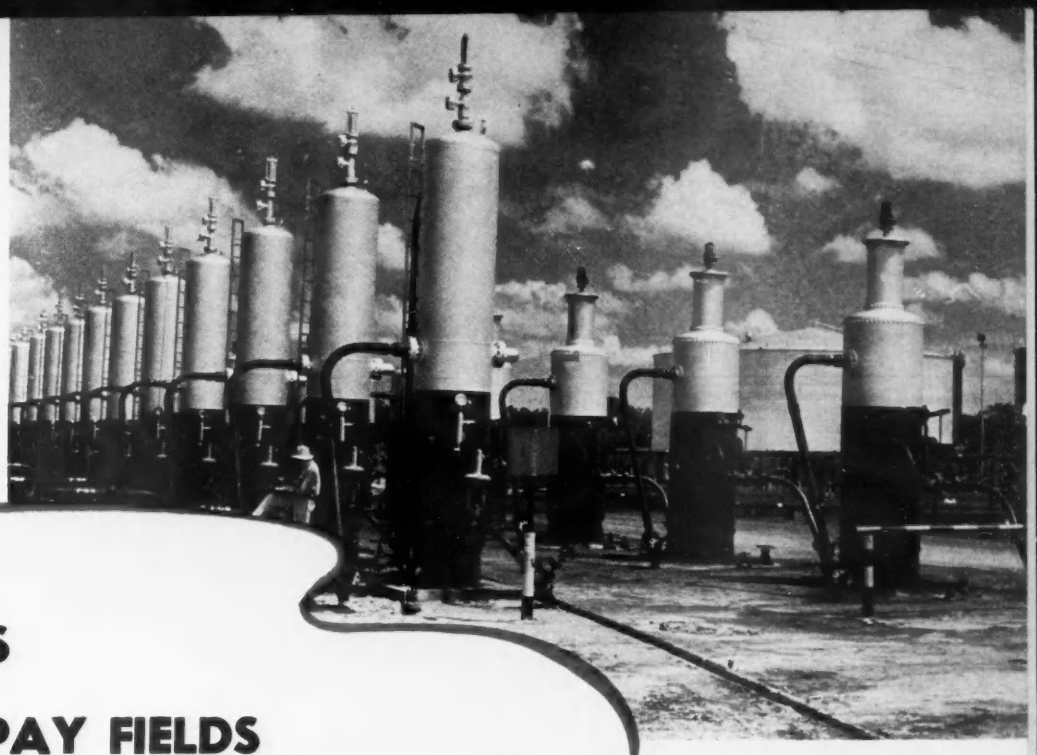
Oil field distributors for Wisconsin Engines and all types of utility units.

How To—Build Detachable Shoe Scraper



A novel use to which a salvaged rod line clamp may be put is contained in the shoe scraper shown in the accompanying photograph. Desirable, and in some cases, essential at any pumping station, office or dwelling, the scraper is easily set up, for it consists only of a short length of rod which is driven into the ground or set in concrete, the clamp, and a salvaged hoe blade or similar piece of metal suitable for converting into a scraper.

Presence of a simple and easily installed device such as this usually invites scraping of shoes, thus preventing needless tracking in of oil or mud. When a blade requires sharpening or must be replaced, the time involved in detaching or re-installing it is negligible.



Battery of high- and low-pressure separators at Block Station "B," north central portion of La Paz Field, now handling production from eight wells.

VENEZUELA'S LIMESTONE PAY FIELDS Step Up Activity

By GEORGE O. IVES
International Editor

THE comparatively new Cretaceous limestone production in Northwestern Venezuela takes on added world-wide importance as the unrest caused by the Palestine partition decision pushes realization of Mediterranean outlets from Middle East fields farther into the future.

La Paz and Mara fields, in the state of Zulia, both give promise of producing in excess of 5000 barrels daily per well, and both are within a comparatively few miles of a tanker loading terminal at the entrance to the Gulf of Maracaibo.

The Western Venezuela region is now producing upward of 900,000 barrels of oil daily, and while the bulk of this is coming from the prolific Bolivar Coastal fields on the eastern side of the lake, the western side is assuming great importance since each completion adds thousands instead of hundreds of barrels to the daily output. Near the end of 1947 La Paz and Mara were producing at a rate of 147,000 barrels daily, of which more than 145,000 barrels were from the 18 wells drilled to the Cretaceous. With more operators now entering the area, and drilling equipment increased to ten rigs with more scheduled, the fields soon will be beyond the present capacity of the terminal, which is 200,000 barrels daily.

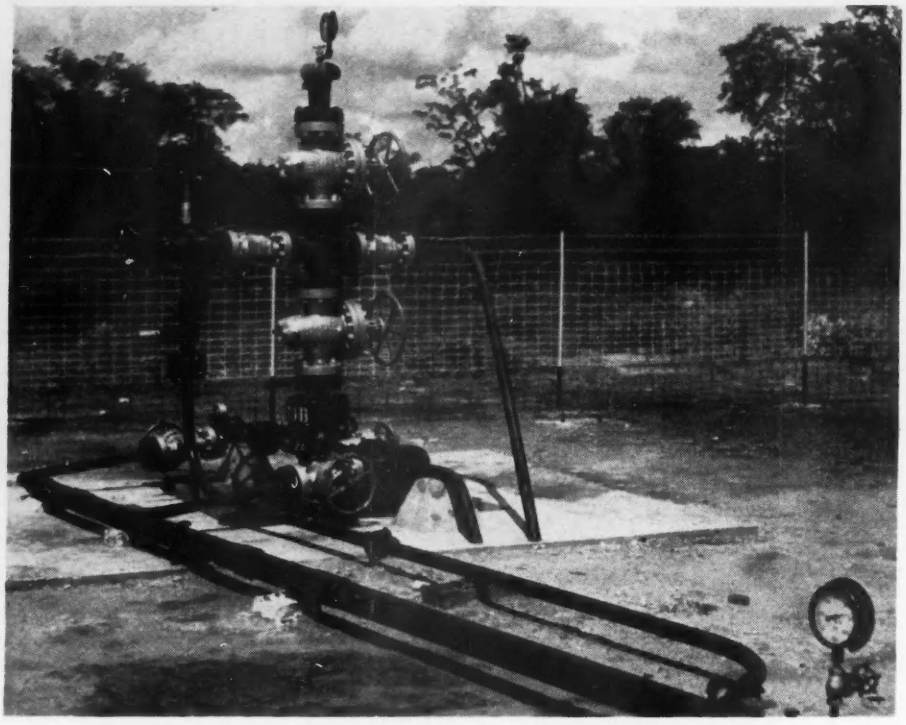
The producing capacity of the wells in these areas, huge pay sections which exist in presently discovered fields, and a great unexplored area, are factors giving rise to optimistic hopes for the future, and as many rigs are now working west of the lake on exploratory operations as are engaged in field development.

Richmond Program

Richmond Exploration Company a subsidiary of Standard Oil Company of California, has been involved in an intensive exploration program on a block of 4,199,000 acres, south of the Mara and La Paz fields, under pressure of approaching expiration of the exploratory period on its concession. In December, 1947, the firm was to have gone into the exploitation phase of its grant, at which time it was to turn back at least half of its acreage into the national reserve. Arrangement has been made for a six-month extension by payment of advance rentals and bonuses, but must go into exploitation in May, 1948. In an effort to properly evaluate its holdings, Richmond has maintained both gravity meter and seismograph parties on the concession under difficult conditions, and has drilled a series of full-scale wildcat wells in somewhat of a "profile" across the holdings. The extent of the undertakings is indicated by the fact that it is 80 miles between the most northeastern well and the one farthest southwest, and other locations are in prospect still farther out.

Very little information has been released by the operators regarding detailed findings in the wells drilled, since they will be in a competitive position should they desire to bid for any of the acreage after its release, but it is known that at least two of the wells have located structures of some kind and are capable of producing oil. Seven wells have been completed with eight rigs now in operation, and five of the seven wells drilled have gone below 10,000 feet. One well being tested is below 14,000 feet, and one of the completed wells is within 24 feet of that depth.

Interest in the area is keen, since at least two Richmond wells reached the Cretaceous, and have doubtless obtained valuable information for correlation of the section along the trend from Mara and La Paz to the Tarra area some 150 miles to the southwest near the Colombian border where this same Cretaceous



Well 73-B, La Paz Field, on a test of several weeks duration flowed 17,360 barrels daily through three 1-inch chokes.

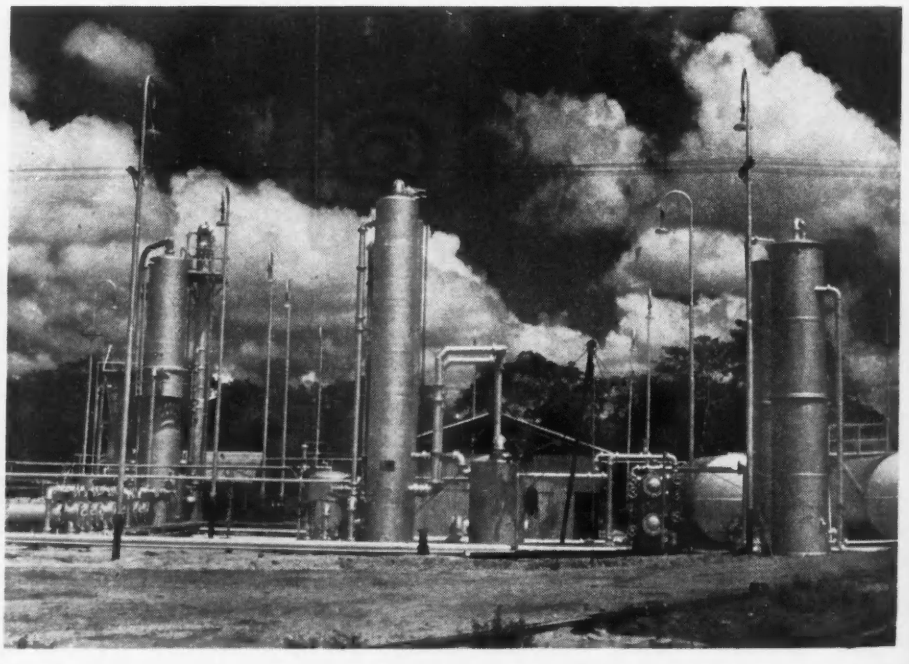
production was found earlier in 1947. The Richmond block is the only area between in which any acreage is likely to be available, and spirited bidding doubtless will be in order after Richmond makes its selection in May.

Well-Located Fields

La Paz and Mara fields are readily accessible from Maracaibo, the La Paz field being only 30 miles from the port city, and Mara a few miles more, although both are somewhat closer to the tidewater terminal at Palmarejo. Movement of oil from La Paz through the two lines (ten-inch and twelve-inch) now serving the field is only some 17½ miles to the terminal, and the twelve-inch line from Mara is only 15 miles long. Separate systems have been installed from each field, although they parallel each other for a few miles just outside the Palmarejo terminal. With rapid development of the fields, particularly at La Paz, several bottlenecks have developed in the transportation system, shortage of pumping capacity at the field, and loading facilities and tankage at the terminal. These are relatively minor, however, and should be erased within a short time. Construction of a permanent pumping station was under way, and new loading line pumps will be installed at Palmarejo. Tankage consists of six tanks with capacity totaling 475,000 barrels, and at the time the writer was on the ground construction was in progress on an 80,000-barrel and a 95,000-barrel tank, to bring capacity to 620,000 barrels.

The terrain is rather flat and arid for the most part in the region of these fields, although some areas of heavy jungle growth are encountered at both La Paz and Mara. Movement of equipment is not too difficult, although considerable roadbuilding is necessary as new wells are started. However, building of these roads does not entail many of the difficult problems encountered in many other portions of Venezuela. The soil is fairly stable and roads can be kept up with a minimum of grading and oiling.

La Paz field is an anticlinal structure discovered and operated as far back as 1922 as a producer from Eocene sand at depths between 1900 and 3000 feet. Production was small until the 1945 discovery of the deeper Cretaceous production. On the crest of the structure the lime was topped at about 5000 feet, and throughout the field as presently proved, the pay section has been about 1800 to 2000 feet in thickness, wells going through the pay into the basement without encountering water. One well was being drilled about 2½ miles to the south in an effort to establish a water table off structure. The structure as now known trends northeast and southwest with steeply dipping flanks to the southwest and less steep to the eastward. The few wells drilled have been on a 4000-foot square grid pattern, with most in a straight line along the structure a distance of about eight miles from northeast to southwest, and about 1½ miles east and west. No dry holes have been drilled, and the south outpost is the first extreme stepout, supposedly off structure or well down on the flank. Average completion depth is around 8000 feet. No abnormal drilling conditions are met, although the formations are rather hard and abrasive, and all drilling is done with rock bits. Average drilling time has been about five months from rigging up to completion, although this is now being reduced somewhat. Oil-base mud is being used in increasing amounts. The casing program is fairly simple, calling for approximately 1000 feet of 5⅝-inch surface pipe, and a full seven-inch oil string set on top of the lime. Completions are made from open



Small absorption unit installed as experimental pilot plant near central flow station in La Paz Field.

hole below the casing in the 1800-odd feet of limestone, which for the most part has been prolific although slightly spotty as to porosity.

Casinghead equipment is quite heavy and all safety measures are taken, more on account of the high producing potential of the wells than for reason of high pressures. Gas-oil ratio varies from about 400-1 to about 600-1, and oil averages about 30 degrees gravity.

Most wells are produced through two or three flow lines. Where three lines are used, two will be taken off the casing and one from tubing, through ¾-inch chokes for the most part. Although normally produced at rates of about 10,000 barrels per well per day, one of the wells, 73-B, was tested for about six weeks through two 1-inch chokes and one ¾-inch choke at an average rate of 17,300 barrels per day. The only appreciable effect was an increase in gas-oil ratio from 500/1 to 510/1.

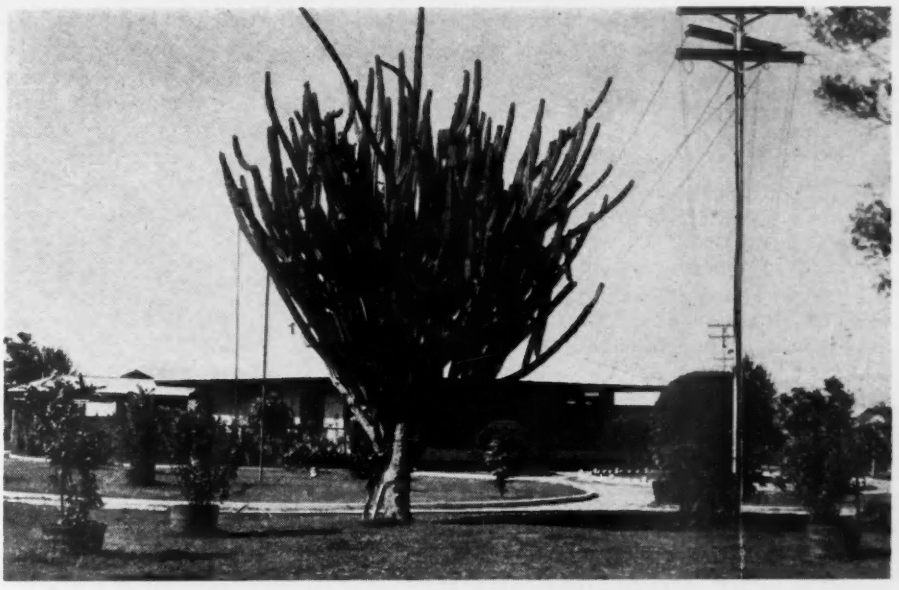
Production flows directly from the well into two central block stations for the field where all separators and pumps are located to care for the oil. At the present time two stages of separation have been used, one operating at 300 pounds and the other at 50. Another stage is now planned to bring it down to atmospheric pressure.

No Gas Problem

With the present small number of wells and comparatively low gas-oil ratio, there is no immediate gas problem. Much of the gas goes into the system for field and camp use and approximately 2 million cubic feet daily is piped into Maracaibo through a four-inch high pressure line to supply that city's limited needs.

A central mud and water system is in use throughout the field, mud and water lines being left in place to be used in event of emergency, or against the time when workovers or repairs are needed. The water is supplied through a pipe line from Punta Piedras on Lake Maracaibo and distributed from La Concepcion, the base camp, throughout the area, including both La Paz and Mara fields. Water for domestic use comes from a reservoir about 30 miles back in the foothills of the Northern Cordillera ranges.

Reservoir studies have not yet revealed the effectiveness of any water drive which may exist, but operators have no present plans for the reinjection of casinghead gas. All gas is gathered through the block stations, however, and at present a certain amount will be processed for recovery of heavier fractions in a small absorption plant purchased from British Controlled Oilfields, Ltd., and moved from the El Mene field. It was ready to start operations just before the first of the year. Meanwhile, there are tentative plans for a modern absorption plant in the La Paz field.



Senior Staff dwelling in La Concepcion, base camp for development of Cretaceous area.

Portion of storage at Palmarejo Terminal.

Venezuelan Oil Concessions, Ltd., the Shell company which owns all the acreage, is presently running three medium to heavy power rigs in the field, and would perhaps add more equipment for drilling if more material were readily available. The three rigs now working can drill footage as fast as tubular goods and other essential materials are made available.

The Shell subsidiary, Caribbean Petroleum Corporation, which discovered the Mara Field, drilled several wells after the discovery in 1946 before other operators holding acreage in the vicinity got started. It was only in recent months that drilling equipment beyond that needed for replacement was delivered, and only now is sufficient drilling machinery coming into the area to support a real drilling program. Now the field has eight wells, six of which are owned by Caribbean, one by Creole Petroleum Corporation, and one by The Texas Petroleum Company. Late in the year Mene Grande Oil Company was testing another well on the west side of the field, which apparently was a commercial producer.

Mara field has essentially the same conditions as apply in the La Paz area 15 miles to the southwest, but here the formations are slightly deeper. The pay section is likewise perhaps a little thicker, running 2100 feet or so in most wells. The presently proved area is

somewhat of a question now, since most of the drilling has been done in a generally east-west direction in a line about five miles long, although two wells have been drilled about four miles south. Creole's well, one of those to the south, topped the lime almost 2000 feet lower than it was found in those drilled along the crest, but still cut approximately 2000 feet of limestone without going into water. On the original test it flowed only 800 barrels daily, but was then treated with 5000 gallons of 15 percent acid, after which it tested more than 6000 barrels daily. Other wells have been completed naturally, but at this time the Shell group is carrying on some acid experimental work in both La Paz and Mara fields, and results have been encouraging, although not yet tabulated completely.

Shell, Creole and Texas have reached an agreement for orderly development of the Mara area insofar as it concerns adjoining acreage. A unitizing arrangement was worked out for the border units whereby Shell will operate them with production distributed on an acreage basis. Each company will operate independently as regards non-contiguous acreage. At the same time an agreement was made that pending further field studies to determine safe efficient rates of production, output from individual wells in the Mara field would be held down to 1000 cubic meters daily (about 6300 barrels) from each well. Arrangements already have been made for cooperative work on gas-oil ratio and water control if and when such problems arise.

Meanwhile, Shell will handle the oil from the field to the terminal at Palmarejo for Creole and Texas Petroleum, operating the line and terminal facilities, but has sold an interest in the pipe line and terminal to Creole and Texas.

In addition to the tankage at the terminal, a wharf has been constructed to carry loading lines to vessels berthed offshore, and it might be possible to start using again the submarine lines used for taking off initial production.

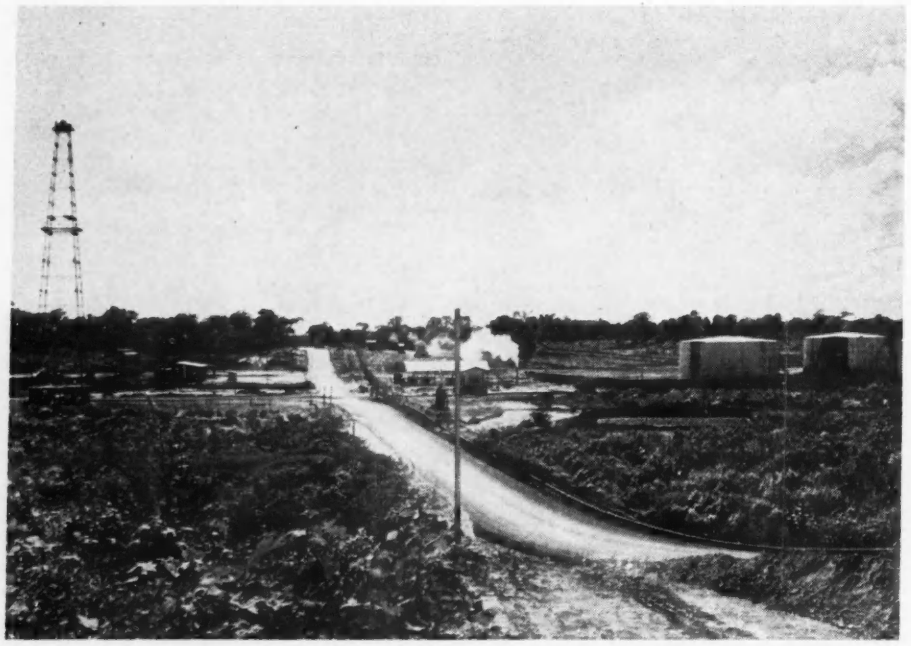
Petroleum concessions on the property used as a terminal have been held by Creole for a number of years, and the company has installed a new extra-heavy power rig on the shore within the limits of the terminal grounds to drill a deep test, Santa Cruz 1.

La Concepcion field, located east of La Paz and south of Mara has been designated as the base from which Shell conducts all its operations in the area, and the camp is being enlarged to take care of the increased personnel and activity. Camps are also maintained at the other fields, but the principal offices, warehouses, shops, and other facilities will be kept at Concepcion. This now has facilities for housing and caring for all the needs of 60 employes known as senior staff, 250 junior staff, and 1250 daily payroll workers. This is in addition to those working for contractors engaged in building the various installations involved in expanded activity, who number between 600 and 800 men.

Among exploratory wells of particular interest to the area are deep tests to the Cretaceous in the Concepcion and the Netick fields, and a deep Cretaceous test by the Shell group at Subicara, just west of Maracaibo and east of the Concepcion field.

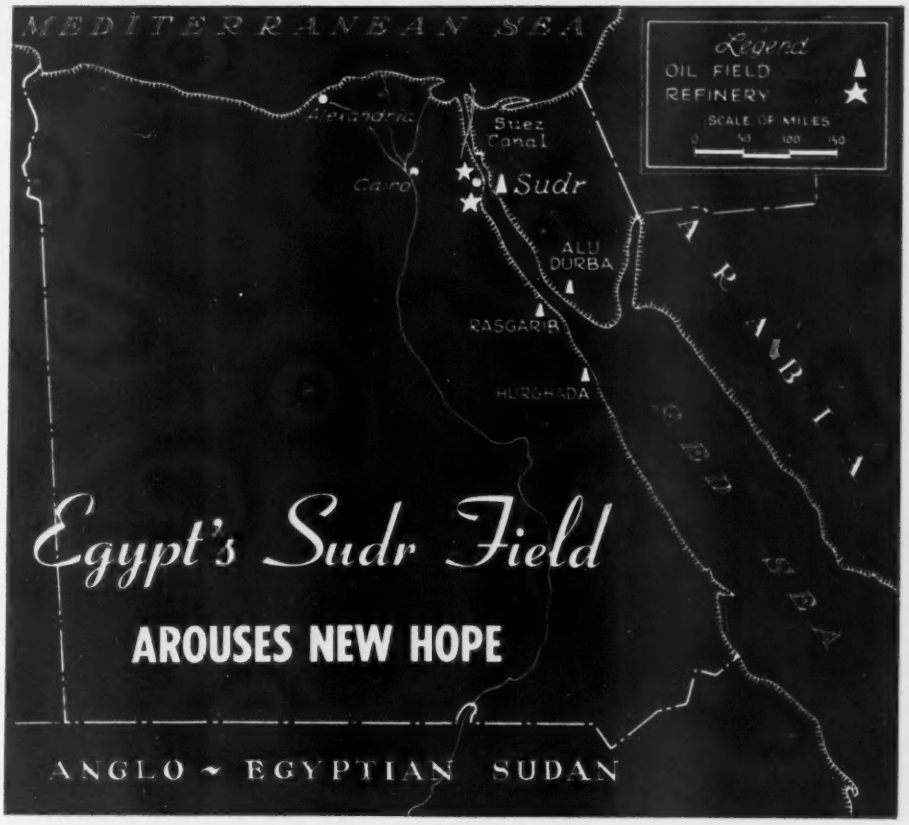
The Netick test is being drilled by Orinoco Oil Company within the limits of the small Netick field, about halfway between La Paz and Mara. It had been looked upon as of extreme importance since success would perhaps suggest a structural connection between the two now producing from the deep pay. Somewhat lower than the other two, it found the lime around 10,000 feet, and had enough showing to warrant running casing, but to date it has not been successfully completed. It has been brought in several times, but has not continued to flow on any test.

Shell was also drilling a deep test to prospect the limestone in the Concepcion field which has 95 small producers from the shallow Guasare pay of the Eocene. It reached 10,000 feet, but has been delayed by fishing jobs and probably will not reach the projected depth of 12,000 feet for some time.



General view of central flow station at Mara field.

Wharf carrying loading lines to tanker berths at Palmarejo Terminal.



Egypt's Sudr Field AROUSES NEW HOPE

DEVELOPMENT of the new Sudr field on the Sinai Peninsula in Egypt has aroused fresh hope for Egypt's future petroleum production. Industry and the Egyptian government believe a new "lease on life" is at hand as far as oil is concerned. Until recently there was widespread pessimism over Egypt's oil future in the face of stationary and even declining production from her three most important fields. Many authorities rate the ultimate production of Sudr at about 40 million barrels, surpassing the now declining Hurghada field, and coming second only to Ras Gharib, which has proved reserves of about 150 million barrels.

In addition to the development of the Sudr field, all the oil companies operating in Egypt are pushing exploration work. These are the Anglo-Egyptian Oilfields (Shell), Socony-Vacuum Oil Company and Standard Oil Company of Egypt, a subsidiary of Standard Oil Company (N. J.).

In the Sudr field, 35 miles south of Suez and 93 miles west of Cairo, six wells have been drilled, of which five were successful producers. The initial rate of offtake is expected to approximate about 5000 barrels daily. The area is being developed by Anglo-Egyptian Oilfields, Ltd., in conjunction with Socony-Vacuum, which will share equally in the production.

The Sudr field discovery was drilled in 1946 to 3157 feet and produced 367 barrels of 24.5-gravity crude daily as a pumper. The other five wells are flowing. Two more wells were brought in at Sudr in the Miocene and Eocene at 7029 feet with a production of 605 and 233 barrels a day respectively, in tests through one-half inch chokes. The latest Sudr completion was at 2658 feet and flowed 4700 barrels daily through a three-quarter inch choke. The flow is attributed to an effective water drive.

Standard of Egypt is reported optimistic over its new location on Tawila Island in the Gulf of Suez. Two tests have been drilled, one of which is still not completed. Feysan 1 went to basement at 3992 feet on Um el Feysan Island, northeast of Tawila. It was completed August 16, 1947, with no showing. Tawila 2, on Tawila Island, was spudded August 17, 1947, and by December 30 was in the Miocene at 6695 feet.

Anglo Egyptian, Socony-Vacuum and Standard of Egypt completed on December 10, 1947, a one year's joint seismograph account conducted by Seismograph Service Corporation, in various parts of Egypt, and at the present time the companies are engaged in individual exploration work. Socony-Vacuum has a Rogers Ray contract party at work there, which operated for the first half of 1947 south of Ras Gharib on a 100 percent account for Socony-Vacuum, and during the last half of 1947 operated in Sinai along the east coast of Suez in a joint account with AEO.

During 1947 exploration was continued without interruption in the Sudr-Asl-Lagio region and is continuing there. In July, 1947, Standard Oil of Egypt started a seismograph party of its own and worked along the east coast of the Gulf of Suez between Abu Zanima and Abu Durba.

Marine Work

In the first half of 1947, Anglo-Egyptian Oilfields had a gravity meter party working on the Mediterranean coast between Alexandria and El Alemain. This was disbanded last summer and an underwater gravity meter crew was put on, operating in the Gulf of Suez, where it is still at work. An underwater gravity crew is also operating in the Sudr area for Socony-Vacuum and AEO jointly. Exploration work other than surface reconnaissance is not feasible in Egypt west of Alemain because of land mines which have not yet been cleared.

In the first part of 1947 Standard of Egypt operated a gravity meter crew in the Hineishat-Wadi Natrun area in the Western Desert, about 93 miles west of Cairo. In the latter part of 1947 that crew moved to the Gulf of Suez on the east coast, but concluded work there in December. It is now at work southwest of Alexandria, between the Qattara Depression and Alexandria.

Throughout 1947, AEO maintained two surface geological parties in various parts of Egypt; Socony had one and Standard of Egypt two. Socony-Vacuum kept two strings at work on wildcats through most of the year, while Shell had one and Standard of Egypt one. AEO also had a core drill and a slim hole drill working most of the year, while Standard of Egypt operated one core drill all through 1947.

Early in 1947, Standard of Egypt completed Abu Roash No. 2, west of the Pyramids, at 5610 feet. Moderate showing had been obtained earlier in Abu Roash 1, completed in September, 1946, in the Jurassic.

AEO is maintaining one string and is engaged in development work at Ras Gharib field, and is keeping another string in extension drilling of the old Hurghada field.

The Kahbra location, on Sinai near the Palestine border, was abandoned by Standard of Egypt early in 1947 at a depth of 10,282 feet, the deepest well so far drilled on the African continent.

REESTABLISHING Trinidad RESERVE

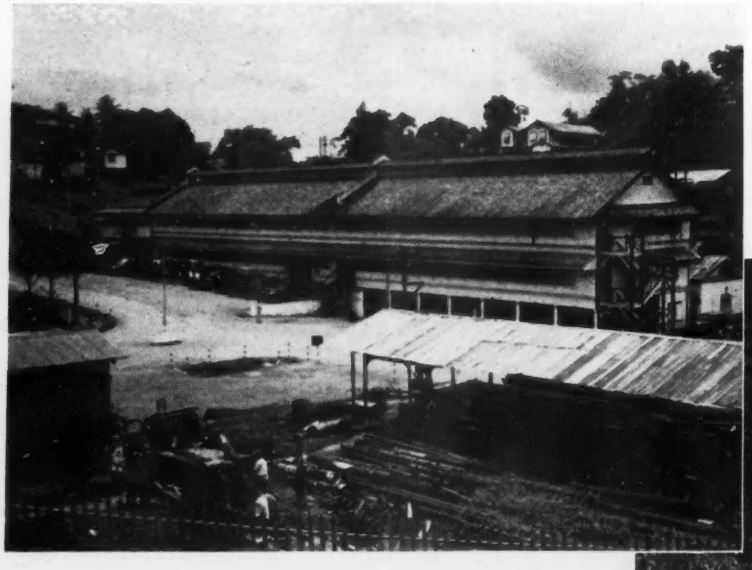
ALTHOUGH still hindered by shortages, Trinidad operators succeeded in keeping an average of 23 rigs running during most of 1947, and production was showing a slight increase over the output of a year ago.

Production for the first six months of 1947 was 10,068,829 barrels, compared with 9,961,976 barrels during the first six months of 1946. However, it was certain that the total output for last year will be substantially in excess of the 1946 production, since during the latter part of 1946 it declined to a low of 53,000 barrels daily. Currently, it was running slightly in excess of 56,300 barrels a day and showing a slight, though steady upward trend. With December figures estimated, 1947 production of 20,344,494 barrels was a very slight increase over 1946 output of 20,173,027 barrels.

The increased production does not necessarily indicate a great increase in the potentialities of the country, nor did it mean an appreciable amount of new reserves. The rate of decline of fields has been found to be quite sharp, and the steady operation of 23 rigs has been just about enough to balance the decline plus giving a small increase. As has been the case since the beginning of the war, most Trinidad rigs are still operating in proved areas and extensions. The most outstanding development of the year was the expansion of the Penal field to the west and southwest, almost doubling its size. Penal has also been joined through production with the Wilson field to the northeast, and drilling on the southern flank of Wilson field has resulted in encouraging production which should enhance its importance materially. This, however, requires more development for an accurate evaluation. Extensions to Penal have been made through drilling of comparatively few wells, and there remain plenty of inside locations to keep several rigs busy for some time. Three rigs are being operated by United British Oilfields of Trinidad in the Penal area, and two more are being operated jointly by this company and by Trinidad Leaseholds, Ltd. Results from the Penal extension wells have been normal for the area. Wilson south flank drilling has indicated that production will be somewhat more uniform than has been found to the north, where it has been extremely spotty, with one fair well to possible two or three poor ones. The latest well in the new area was completed with a potential of 1500 barrels daily, the best thus far, and sand conditions have been found to be much more uniform.

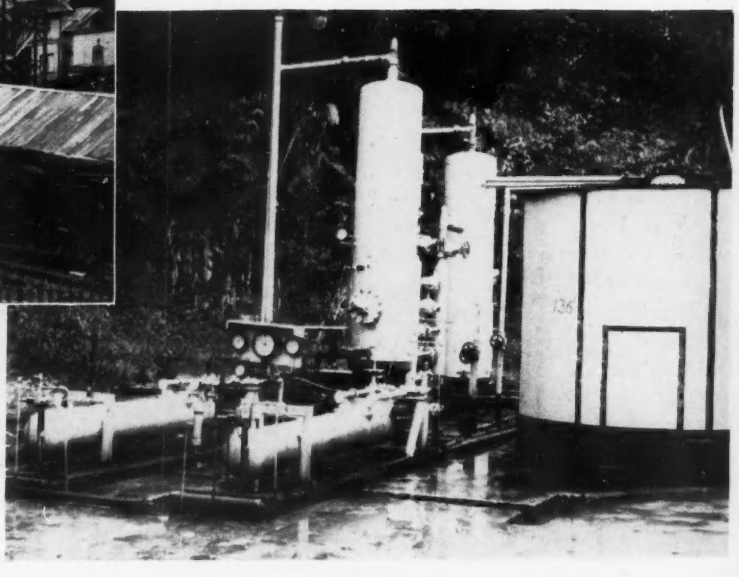
New Area

Meanwhile, a new area, not yet evaluated, is likely to be developed in the southeast part of the Island, north of the Guaguayare fields, where one rig has been engaged in exploratory drilling. Several wells have been drilled in



General field offices of Trinidad Leaseholds, Ltd., at Forest Reserve. Portion of materials yard in foreground where all used field material comes in for rehabilitation or salvage.

Flow station in a Trinidad oil field. This installation is fully automatic, separating, gauging and moving oil from a block of flowing wells.



an effort to outline a structure picked up by geophysical means, and some tests have been run, although none of the wells are on production. Present information promises nothing outstanding, but it should prove to be a rather broad area with sand conditions seeming to preclude the possibility of wells of any magnitude, although they should be fairly uniform and at reasonably shallow depths.

Exploratory work was limited to one rig through the early months of 1947, but there are now three rigs working on drilling of this nature. In the Brighton area, the Antilles company has a well waiting on casing at 6562 feet before going on down to its contract or projected depth of 7500 feet. At the present depth it is into the Cretaceous with tentative top picked at 5555 feet, but nothing encouraging has been reported. During the year, UBOT completed Trinidad's deepest well in the Cruse field to a depth of 11,042 feet, without finding deeper production.

An interesting area scheduled for exploration is the central area of the island north and northeast of the present producing fields, where Trinidad Northern Areas has exploratory concessions and has started some geological and geophysical work. Trinidad Northern Areas is an operating company participated in by Trinidad Leaseholds, UBOT and Anglo-Iranian Oil Company. This new concern is also interested in some of the properties which may be allotted in the Gulf of Paria.

Much talk regarding the possibility of the Gulf of Paria submerged being possible oil-bearing territory still remains as pure discussion, since there has been no real work done in the area other than geological projection of trends and stratigraphy. No seismograph work has been started, and it is now unlikely that any will be done before a final decision is reached on the method and conditions of allocating licenses from the government of Great Britain to the individual operators.

Although applications have been made for licenses covering a substantial portion of the submerged lands, the government has not yet signed any of the grants, and has indicated that it will not start granting them until full interpretation has been agreed upon regarding royalties, etc. It is understood that the government is insisting upon an interpretation which will result in a net 10 percent royalty.

Repressuring Project

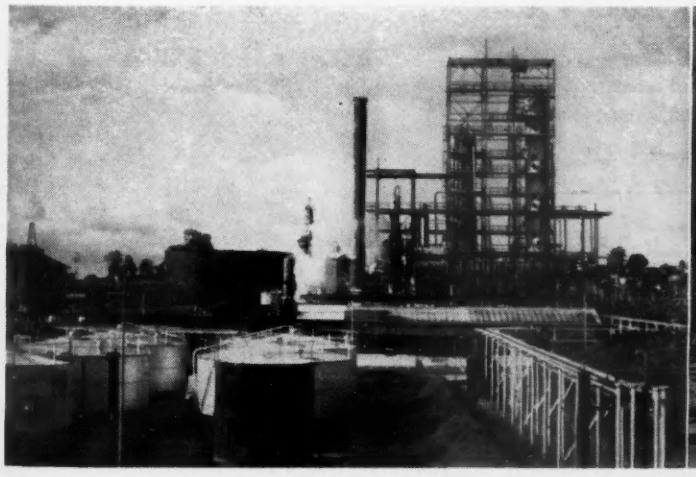
Of interest in Trinidad oil areas is the increasing trend toward returning gas to the reservoir after processing for heavier fractions. Trinidad Leaseholds, Ltd., largest producer in the Forest Reserve field, has been working on building up a repressuring project for more than a year in that area. It is now returning gas to the reservoir in increasing amounts, which have increased from a few million cubic feet monthly around the first of 1947, to averages of around 100 million cubic feet monthly at the end of the year. Cycling has also been instituted in the Guayaguayare area by this company which is now returning about 50,000,000 cubic feet daily to the reservoir. The firm has always made good use of its casinghead gas as a source of fuel and a factor in its automatic metering systems for crude production, but has been returning the residue to the reservoir only a comparatively short time.

Two other concerns, Apex Trinidad Oilfields, and Trinidad Petroleum Development, have been cycling gas for some time, both companies having been operating plants for a number of years.

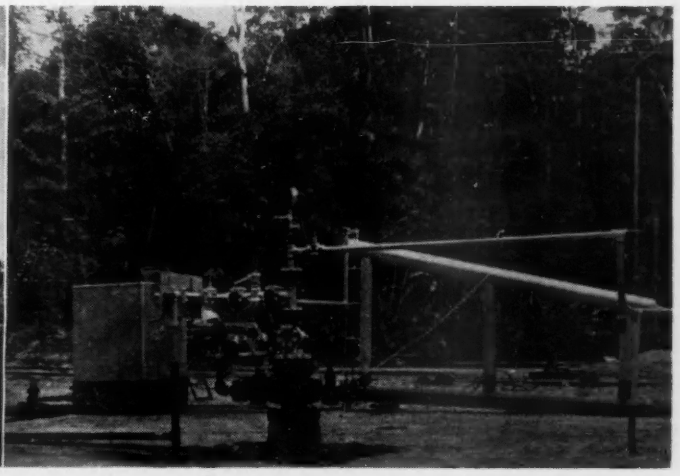
The Apex plant is treating an average of around 240 million cubic feet monthly, from which it recovers 7800 barrels of liquid products. The Trinidad Petroleum Development plant is handling about 225 million cubic feet monthly from which it recovers approximately 7000 barrels of fluid. Recovery in both plants is on the order of 1.06 gallons per thousand cubic feet of gas processed.

With the 23 drilling rigs now in operation, some of which are new, as replacement for the machinery worn by years of continued service, Trinidad operators are not especially short on this type of equipment. Dollar cuts were made after much of the new equipment had been ordered and a good part of it delivered. However, the biggest pinch is being felt, and probably will continue to be felt, in tubular goods. This item is extremely short in supply and very little relief is in sight. The feeling among operators is that the dollar shortage makes comparatively little difference since they probably would get deliveries just as slowly from the U. S. as from the United Kingdom.

Gradual replacement of reserves depleted by the wartime drafts is being effected, so that it is felt that the producing rates may be increased slowly without causing undue harm to presently producing reservoirs, but the great need is for substantial new reserves as yet undiscovered by drilling. For this reason the progress of Trinidad Northern Areas in its search for production in the central Trinidad area will be watched with great interest, as will the results of wildcatting which might take place in the Gulf of Paria. However, the actual drilling of the submarine areas off the coast must await a final agreement between prospective licensees and the government.



UBOT refinery at Point Fortin, where two topping units can handle up to 30,000 barrels of crude daily.



Water knockout in use on Trinidad well making a small amount of water.

Multiple stage cement job with motor power equipment. Fifty-two Venezuelan "nationales" were required to cut 1200 sacks of cement.

VENEZUELAN CEMENTING PROBLEMS

By G. JACK BENGE,
President, Cia. Halliburton de Cementacion y Fomento

MANY cementing problems encountered in drilling operations in Venezuela are quite similar to those found in the U. S. However, there are certain factors resulting from climatic conditions and transportation difficulties in Venezuela which present problems with which the average American operator does not have to contend. The following article does not pretend to discuss all the difficulties encountered in well cementing work in Venezuela but only a few conditions which might be of general interest to the petroleum engineer.

During early oil development work in Venezuela one of the first problems encountered in well cementing practices was in the tendency of sacked cement to absorb moisture and thereby result in premature setting. An average of 30 percent of the cement in each sack transported to a location was found to have deteriorated into lumps which not only resulted in mechanical failure during well cementing operations but constituted a serious economic problem, as the average cost cement per sack at well location was $2.50. This high percentage of deterioration was the result of excessive humidity of the Venezuelan climate supplemented by the long boat trip and the manner of storing cargo on the wharves. To overcome this problem arrangements were made to ship the material in asbestos-impregnated paper sacks and also to reduce the quantity shipped at a single loading. The practice of spreading a year's supply over a number of shipments tended to cut down the time the warehoused cement was exposed to the humid atmosphere.

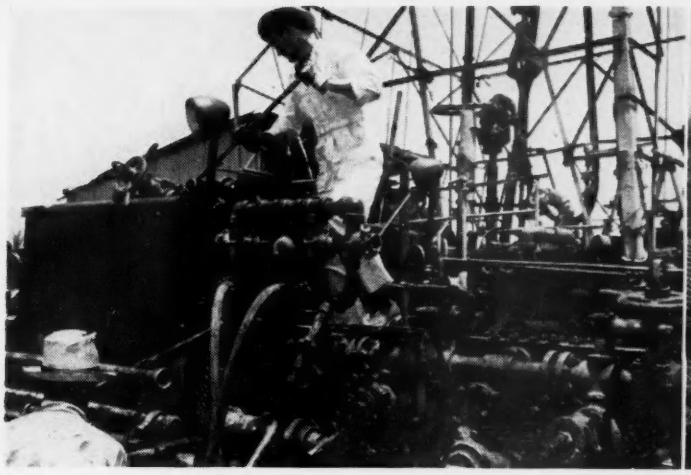
Protecting Cement

Cement was tiered not over 10 sacks high on boards and covered with tarpaulins at well locations to protect it against the drenching rains. Packaging of cement in barrels was tried, but the higher cost of the barrels as well as the extra labor necessary for opening and inconvenience in handling practically eliminated this method. Bulk cement transporting equipment is now being used both in Eastern and Western Venezuela. This system definitely improves the quality of cement at well location and eliminates a great part of the high cost of handling and sack breakage.

A workover program was inaugurated in 1942 in one of the oldest producing fields in Eastern Venezuela. This program called for the drilling of many new inside locations. The newly-penetrated producing horizons were drill-stem tested with open hole packers. Results of these tests indicated that the producing characteristics of the early wells which were cemented by the conventional plug method were considerably lower than

About the Author: G. Jack Benge was born in Oklahoma in 1914 and graduated from Oklahoma University with a B.S. in Petroleum Engineering. He was employed by Halliburton Oil Well Cementing Company in 1935 and three years later took the firm's first equipment to Venezuela. He is well known in South America and has specialized in cementing problems encountered in the Venezuelan oil fields.

MULTIPLE STAGE cementing helped to solve production problems in a workover program in one of the oldest producing fields in Eastern Venezuela, while the use of wall scrapers eliminated isolation squeezing in another area and saved time in well completion. These and other cementing problems are discussed here by a man who has been working in Venezuelan oil fields for nearly ten years.



High pressure fluid manifold on a steam truck used for high pressure squeezing.

Steam power pumping equipment being used to pressure test cemented perforations prior to testing an upper sand.

now could be expected. This indication was confirmed by washing the perforations and injecting oil into the productive zones of the old wells.

The increased production resulting from the washing made it obvious that the oil sands were being sealed with cement to such an extent that normal gun-perforator bullets were not penetrating far enough to establish adequate flow channels. This conclusion was further supported by the permeable nature of the boulder and cobble strata comprising the producing section. Considering the above as well as the fact that this field had been producing for over 15 years, thus suffering considerable pressure decline, it became imperative that a method be employed whereby cement would not come in contact with the producing sections and that high pumping pressures be avoided.

The multiple stage cementer was selected to overcome this problem. Complete penetration of all productive zones with full size hole was established as the drilling program. The casing string was then made up of : (1) perforated pipe section on bottom, the length of which was governed by the thickness of the lower sand; (2) immediately above perforated section a solid bottom baffle collar; (3) blank pipe, length governed by spacing of two productive zones; (4) multiple state cementer; and (5) blank pipe to complete string.

The amount of cement to cover the area from the baffle collar, approximate top of lower productive zone, to the bottom of the top productive zone was calculated on the basis of a previously run caliper log. Approximately 300 sacks of cement were used for the second batch, run through the multiple stage cementer, to secure the top portion of the casing and to cover the deep water sands. Thus, the cement never came in contact with the producing zones and pressures were reduced considerably in pumping cement around the pipe.

The pre-perforated section or lower zone could be brought in by washing or swabbing immediately after cleaning out casing. The upper zone could be brought in as a dual porducer by gun-perforating the pipe. This method is now being used on approximately 85 percent of all new wells drilled in this re-activated field.

Ten Sand Sections

The lower section of the Jusepin-Santa Barbara area as a general rule will have ten or more sand sections which are separated by beds of shale. These formations possess qualities which make it rather difficult to obtain satisfactory isolations by the normal method of casing cementing. The main source of failures in cementations was believed to be the bond between the cement and the shale formations. This bond was necessary to properly isolate the multiple sand formations. Since the bond can never be stronger than the formations, squeeze cementing through gun-perforations opposite the shale proved the shale-cement bonds were not strong enough to stop migration. It was found, however, that "squeezes" opposite the upper and lower contacts of a sand formation would successfully isolate the sand. Thus, several operators made a practice of performing their isolation squeezes through 5 to 8 one-half-inch perforations opposite the contacts immediately after casing cementation and before placing well on production. The number of squeeze jobs and days of lost rig time were high as several isolations had to be made on each well which might be completed as a dual or triple producer. By actual count in one area it was found that 28.8 percent of the squeeze cementing jobs performed was for sand isolations.

Considering that good bonds could be made at the sand-shale contacts by squeezing, it then became necessary to determine why these bonds could not be made on initial casing cementations. Though drilling muds were under strict inspection and considered of excellent quality, their colloidal properties were greatly affected by the cement slurries. A very small quantity of the cement slurry would cause the mud to jell and the consistency would become such that the mud would have a very high angle of repose. Apparently the jelled mud formed on the interface between the formation and the cement slurry; thus this jelled section of mud and cement slurry would not move with laminar flow.

The isolation squeezes were removing the jell; therefore, to break up the jell at casing cementation, mechanical scratchers were employed. Rotatable-wall cleaners were used because they scratched the wall of the hole and also served as centralizers without obstructing fluid flow and still would cause a minimum of hole disturbance when running casing. Five-foot sections of the cleaners were placed on the pipe at points which would scratch the sand-shale contacts when the casing was landed. After casing had been run, circulation was established through a swivel connection at the surface and maintained at normal speed for some time before beginning rotation. The casing was set on the slips and rotated with the rotary table. Circulation was maintained until material cut off the wall by the cleaners had returned to the surface. Cement was then mixed and pumped into the casing. Rotation was stopped only to insert the cement plugs.

This procedure has practically eliminated isolation squeezing in this area, thus saving many days in well completion time.

Acknowledgment

The author wishes to acknowledge the assistance of the field personnel of Compania Halliburton de Cementacion y Fomento in collecting data for this article.

Visual Information AIDS MANAGEMENT

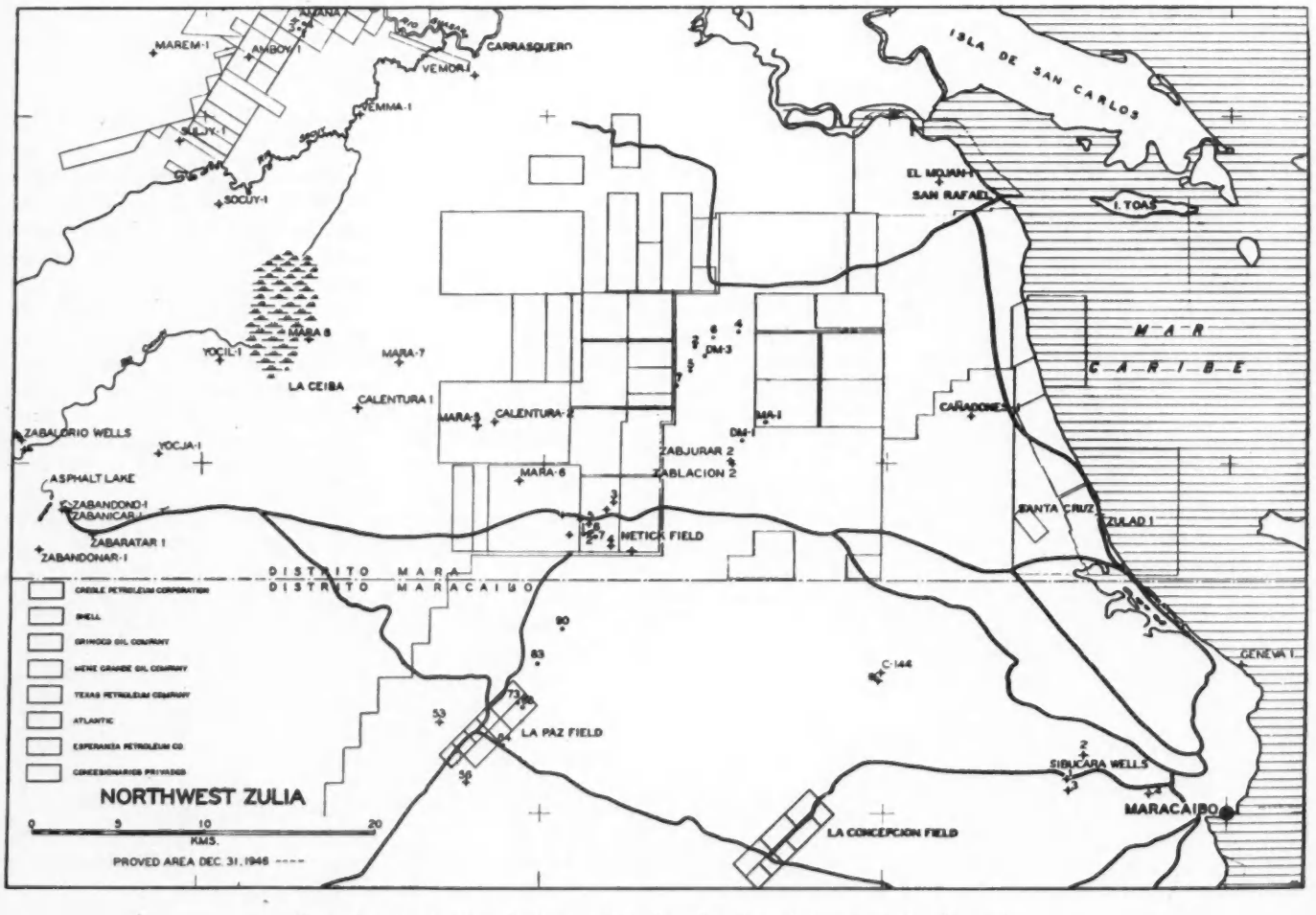
A LEADING foreign operator has evolved a visual information system by which management, with a minimum expenditure of time, is kept fully informed on all pertinent details of industry activity.

An adaptation and refinement of ordinary slide projection, the system has almost unlimited flexibility, and has developed to where management and department heads can get a complete picture of the week's operations in a little more than half an hour. This contrasts with weekly meetings which formerly consumed hours; and all who attend come away with a better understanding of proceedings than normally would have been possible. Executives say it saves them many hours each week of reading and digesting the numerous daily and weekly reports.

Creole Petroleum Corporation, employing the system at Caracas, Venezuela headquarters, began using occasional slides about three years ago when it was necessary that an entire group see and discuss a problem involving maps, logs, and charts. Finding that this had the dual advantage of ease of concentration as well as convenient display, the use of slides was continued, and considerable thought and ingenuity has gone into the process of developing the smooth-working system in use today.

Time, thought and expense are necessary to put such a system into operation, but its users think it well worth while.

Basically, the procedure is this: Scouting material is gathered by the company organization in much the same manner as it is assembled in the U. S., and submitted to the management in the form of the usual type of weekly reports, letters, tabulations, etc. These go to the management, but once a week, a day in advance of the weekly meeting, the geologist reviews the reports



Type of area or regional map used to show location of important development.

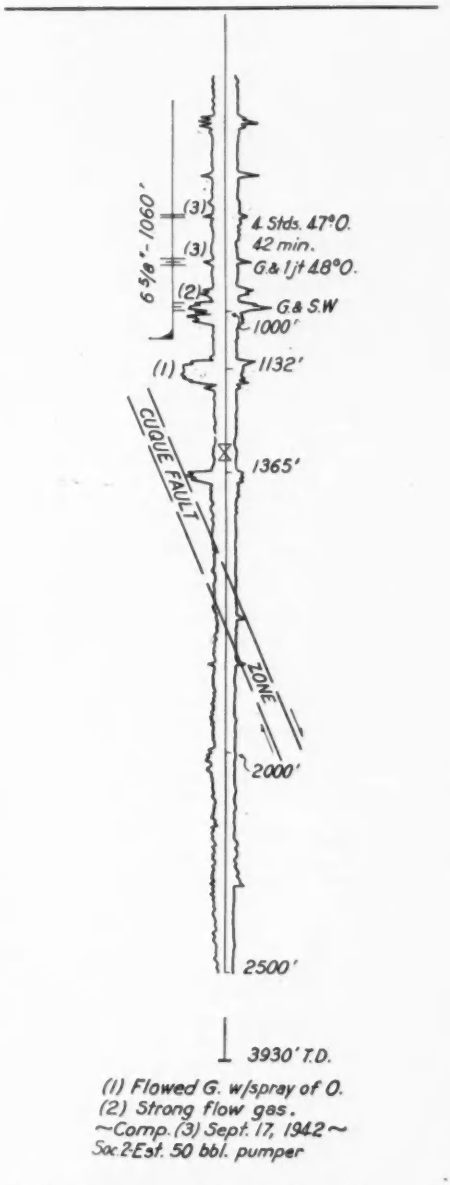
and works with the head draftsman to see that all pertinent data relating to drilling are posted on standard base maps. Symbols call attention to operations of interest to the management. These include extension wells, deep tests, discoveries and operations of other firms which have a bearing on company acreage. A short report calling further attention to these points and their significance is prepared for presentation by the person presiding at the conference. When maps are posted they go to the photographic department where they are photographed directly onto film for making 35 millimeter slides. The slides are placed in 2 x 2-inch standard slide holders for projection at the conference. The mechanics of making these slides has been simplified through experience until it is now possible to deliver a finished slide within 20 minutes from the time the map is received from the draftmen. This time includes a period of baking necessary to dry the film thoroughly to prevent its curling in the projector.

This same procedure is followed for geological sections, electrical logging, survey charts, subsurface contour maps, etc.

In preparing the base maps, all permanent data are shown on the original base, including land lines, wells, etc., on a transparent film stock which shows little tendency to contract or expand with changing heat or humidity. All information subject to change, such as contours, proposed programs, etc., is put on a separate sheet of the same material to the same scale and used as an overlay or underlay as desired. While being photographed the base map and its overlay are held securely in a vacuum frame.

Electric Log Symbols

An interesting set of symbols has been worked out for electric logs of individual wells as projected for viewing. These indicate at a glance where casing was cemented, where squeeze jobs were performed, where perforations were made for tests, and also whether these were the perforations left open for final completion. In addition, brief notations show results of various tests and initial production of a completed well.



Typical logs in producing areas will show casing seat, perforation points, tests, and other data.

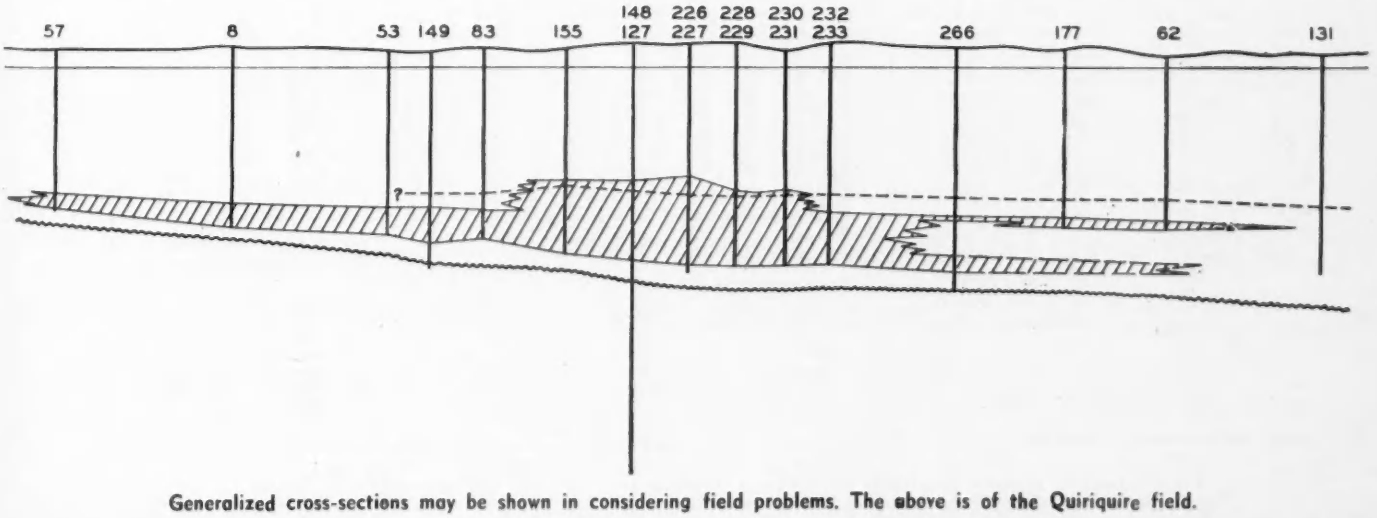
In addition to this type of material the company has found it practical to make slides of field photographs, so that it is possible to show progress of construction on plants, layout of installations, or anything else of interest and value to the group. Field personnel has instructions to send in pictures of flow stations, bridges, piping layouts, etc. The simplicity of the process for making the film slides at a cost of only about ¼ cent each makes it possible to adapt almost anything to the system.

The process is taken a step further in that projectors are now provided in the New York office, and slides can be mailed. As many as four dozen can be sent in a small envelope less than two inches square, clipped to the regular weekly reports.

This, in turn, has led to still another step in standardization. A complete set of the 20 x 24-inch maps is maintained in the New York office, taken from the same film base as those in Caracas, and can be kept posted from the film slides. A procedure is worked out whereby in the case of contour maps for instance, the new slide is placed in a projector and projected directly onto the base map in New York and it is possible to trace new contours by following the image, so that all geological maps are identical, and can be kept posted almost simultaneously.

Two Projectors Used

Two projectors used in the conference room are of a rotary type which can be controlled by push buttons at the speaker's station. By this means, a map may be shown of an entire oil field or portion thereof, or of a wildcat area, with critical or interesting wells indicated. At the same time the other projector can throw

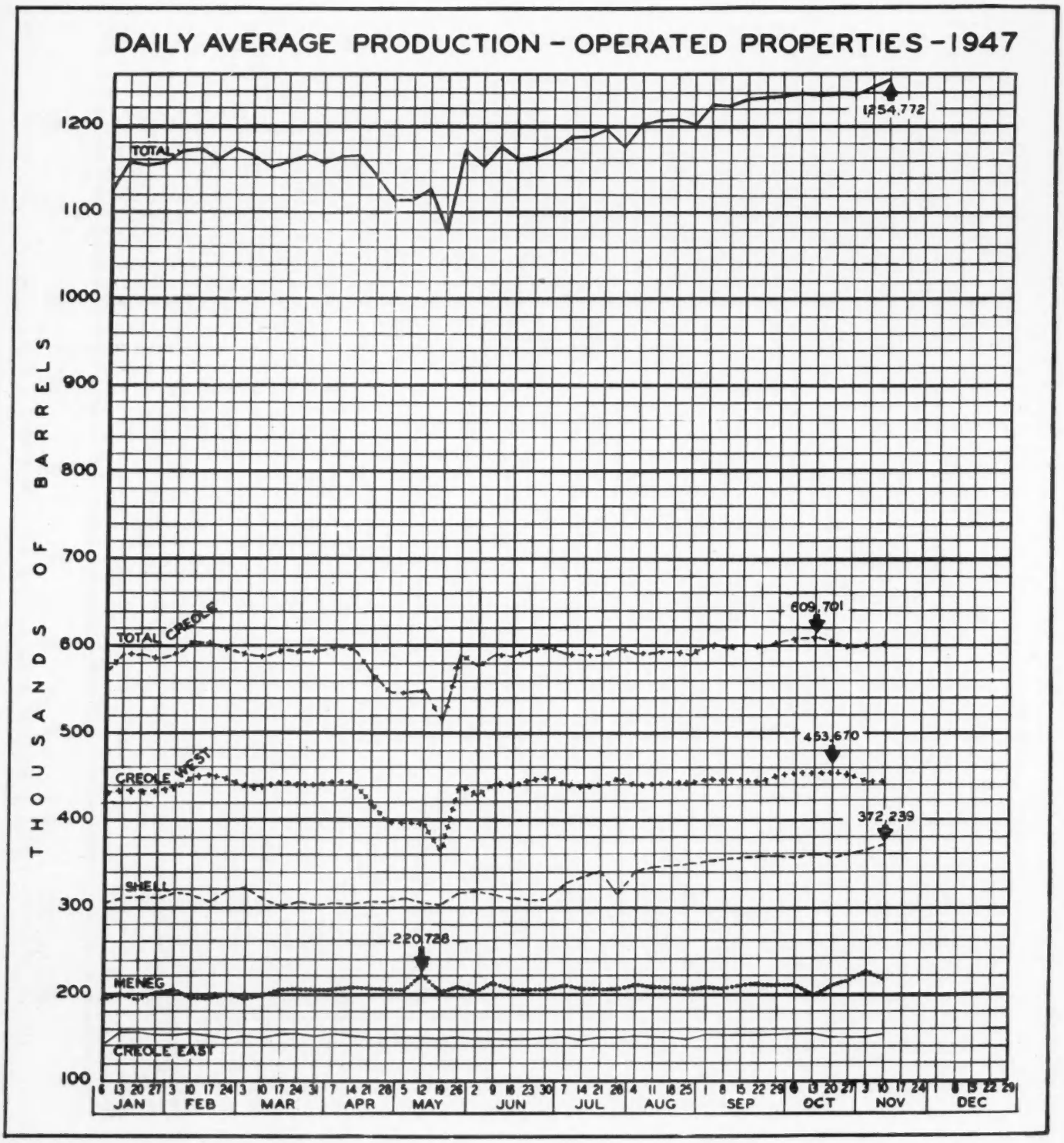


Generalized cross-sections may be shown in considering field problems. The above is of the Quiriquire field.

an image beside it showing a cross-section drawn through wells under discussion, or an electric log of each, so that an immediate view is given of the position of wells together with information shown by drilling or testing. The whole picture is then fixed in the mind of the viewers far better than would be possible by a study of reports and maps in anything like the same amount of time.

A further step in standardization grew out of the set of maps and charts built up on film base for making slides. The large lettering lends itself readily to reduction, and consequently the same set of maps is used in making up the handbooks issued to all department heads and management. The larger maps are reduced to approximately 8 x 10 inches for reproduction by offset methods, and complete uniform handbooks, and bases for new editions are available in up-to-date form at all times.

This form of weekly digest was originally designed for top management, which immediately saw its value and expanded the conference to take in engineers, economists, transportation experts, department heads and other interested parties. However, interest has been so great that it has now become necessary to limit attendance to some extent. The conference is now affectionately known around the office as the "Mickey Mouse," or plain "Mickey," since some wag, attending for the first time, came out of the meeting with the remark: "All this and no Mickey Mouse?"



Regular weekly charts show daily average production trends with peaks indicated by arrows.

In the Wietze oil field, province of Hanover, the oil sand is mined through two 750-foot shafts, the oil then being "squeezed" from the sand by washing with steam and hot water, and the depleted sand returned beneath the ground through drill holes.

An old potash mine, 3000 feet deep, near Volkenrode, Thuringia, where oil is now produced, while potash is still being mined.

Germany Looks To Emsland for Oil

GERMANY'S oil production for 1947 was more than 1 million barrels less than the 4,548,000 recorded in 1946, further evidence of the heavy drain placed upon its principal producing fields under conditions brought about by the war. However, several comparatively new areas are expected to make up the total in some measure once the materials situation loosens up. Wartime necessities proved that the sedimentary basins of some European countries were not so poor as had been supposed.

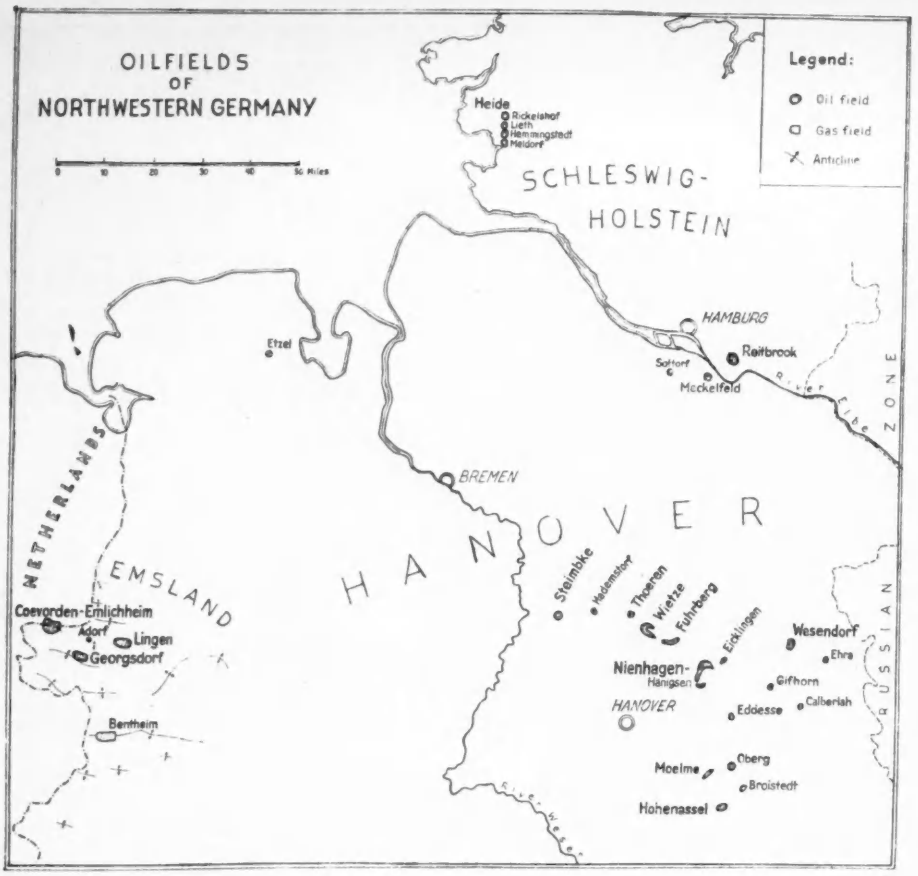
The Germans' intensified search for oil resulted in broadening the oil areas, not only in the older Carpathian districts of Roumania and Galacia, but also in the Alps foothills in southwest Hungary, Lower Austria, Middle England, Northwestern Germany, and the German-Dutch border area. Output compared with that of the U. S. or Venezuela seems insignificant, but is nonetheless of extreme economic importance to those countries such as Germany which lack exchange for the purchase of petroleum and products from overseas.

In Germany before 1934 there were only four old oil fields being exploited. Now there are 25 oil and one gas field in production. The oil search in Thuringia and Baden which was instituted several years ago has been unsuccessful, while a more favorable result is expected from the prospecting now going on in the Bavarian-Swabian Molassetrog (American Zone) stimulted by results in the Austrian foothills of the Alps.

Divided into four zones of occupation, with their different modes of control; with industry destroyed by the war, and with many shortages which show little prospect of solution, Germany is urgently dependent on the utilization of her own raw material sources to help restore a normal living standard. The oil fields in the province of Hanover, in Schleswig-Holstein and at the Dutch Border (Emsland), to a considerable extent discovered just before and during the war are helping in some measure to offset the need for motor fuels and other products. German crude is largely of paraffin base and its main product is lubricating oil which can be treated in refineries at Hamburg, Bremen and Misburg. In the western district the local supply is sufficient to cover the restricted need for lubricating oils, kerosine, bitumen, fuel oil and other special products, but gasoline and diesel oil, or crudes from which these may be derived, must be imported. For the western zones the foreign supplies of finished products amounted to more than 5 million barrels during the first nine months of 1947. In the future it is expected that most of the imports into Germany will be in the form of crude.

Of particular concern to operators in Germany was a recent regulation by the North German Oil Control which would restrict the use of materials in the smaller fields, advocating the view that drilling wells in the less productive areas will have to be greatly restricted or stopped altogether in order to release more equipment for the development of the more promising deposits in the Emsland area. Private companies propose to continue operating in some of the areas with makeshift materials available locally, particularly since much of this is unsuited to the needs of places like Emsland. In addition they contend that complete stoppage would leave many experienced workmen in the areas who would not be transferred to Emsland. In some of these areas affected, it would be possible to continue to drill producers at depths of around 400 feet.

One of the principal problems in Emsland has been the procurring of additional labor in the face of a housing shortage and lack of other facilities. However, the North German Control has indicated that it may find it possible to obtain release of a camp at Bathorn, near the fields, which had hitherto been occupied by displaced persons. Meanwhile, the industry in Germany has



managed to hold a drilling average of nearly 40,000 feet a month, of which in recent months more than half has been in exploratory work.

Production during the war years of 1940-1945 was particularly increased in the Reitbrook and Heide fields. At that time the Reitbrook field was greatly overproduced by order of the Ministry of Economy against the wishes of the technical advisers. As a consequence the field went into a rapid decline and the total output of Northern Germany showed a corresponding drop. The Nienhagen field in the Hanover area, which long has been the best single source of production, was yielding more than 2½ million barrels annually before the war, but is presently contributing less than half that amount. From observation during the past years it is evident that the salt dome fields of Northwestern Germany are, with the exception of Nienhagen, not very productive, so German technicians are looking for intensive exploration work around the more than 200 salt domes known and mapped in the area to equalize the production decline in these fields.

Geological conditions in the Emsland apparently are more favorable. The first of these fields, Lingen-Dahlum, was discovered by reflection seismograph in 1942 following the partial development of the gas field north of Bentheim which had been found at the end of 1939 at a depth of 5200-5200 feet in the Plate Dolomite. The fields in this region are anticlinal in nature in contrast to the salt domes of the Hanover region, and should be more productive. Proved reserves in Emsland are estimated at 25½ million barrels with probable reserves placed at that much more. Hanover and Schleswig-Holstein on the other hand are estimated at no more than 18 million barrels with probable reserve negligible.

Emlichheim, which is that portion of the field which straddles the Dutch border, and which is called Schoonebeck on the Dutch side, is the best field in Germany from the standpoint of reserve, and although a comparatively new field, having been discovered in 1944, is now second only to Nienhagen in volume of output, producing at a rate of 41,000 barrels monthly from the 30 wells drilled to date. Output here is hampered somewhat by a shortage of narrow-slotted liners used in completions because of the peculiar sand conditions. Its proved reserve is estimated at 15 million barrels.

TABLE 1

COMPANY	Prod. Jan.-Sept. 1947 in Barrels	Percentage	Cumulative Prod. to Oct. 1, 1947
German Private-Owned:			
Gewerkschaft Elwerath	754,461	25.1	18,930,051
Deutsche Frodel A.G.	596,147	19.9	21,440,538
Wintershall A.G.	449,118	18.3	9,587,403
Itag	39,126	1.3	1,748,250
C. Deilmann	37,126	1.2	279,720
Others	15,301	0.5	
	1,991,279	66.3	
Foreign Private-Owned:			
Deutsche Vacuum Oel A.G.	329,902	11.0	8,636,355
Gew. Brigitta (Shell and Standard of New Jersey)	325,244	10.8	3,727,269
	655,146	21.8	
State-Owned:			
Preussag	220,741	7.4	5,727,267
Schachtbau-Terfbohr-Gesellschaft	99,825	3.3	384,615
Braunschweig Bohrgesellschaft	35,147	1.2	258,741
	355,713	11.9	
Grand Total	3,002,138	100.0	70,720,209

Hanover Region

In the Hanover region are situated the greater number of Germany's oil fields, and the entire region accounts for well over half of its total output of crude. Here is located Wietze field, the oldest of oil sources being produced in the nation. Oil has been obtained commercially here since as early as 1874, and its total accumlative production of 16¼ million barrels is second only to Nienhagen. The field is somewhat similar to Pechelbronn in France in that it produces from mine shafts as well as from conventional oil wells. Its early production came from open pits or shallow wells, and now mining has proceeded to shafts 800 feet in depth, where oil is both drained off in the shaft and the sands are mined for processing at the surface. Production has now declined to about 13,000 barrels monthly. and remaining recoverable reserve is estimated at little more than 1 million barrels.

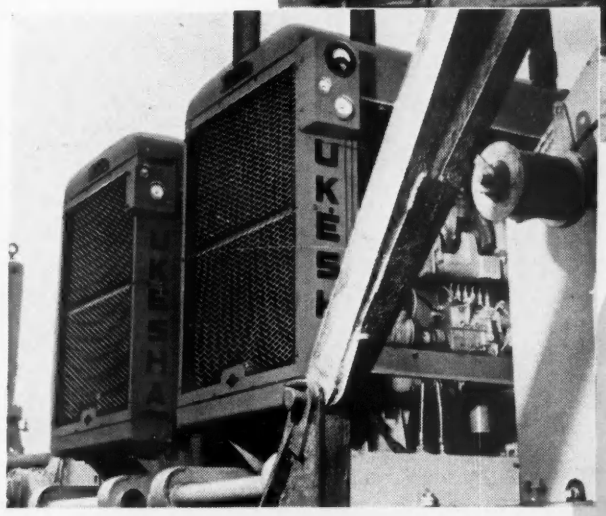
Nienhagen, just northeast of Hanover, is a dome-type structure with production mostly on the northwest flank, it has accounted for more than 31 million barrels since its discovery in 1904.

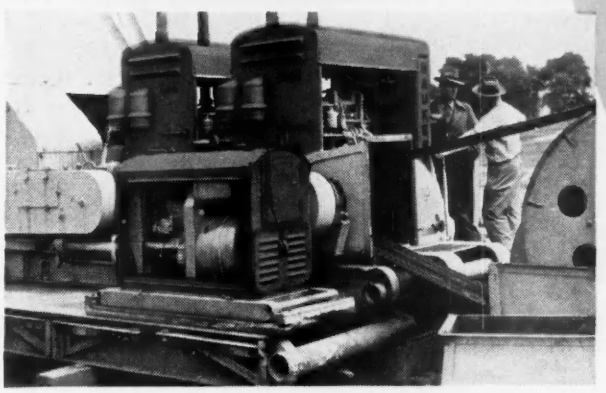
Some attempt has been made by the provincial government of Schleswig-Holstein to nationalize its mineral resources, a bill having been passed to that effect several months ago, but inasmuch as the bill needs the consent of the Control Commission it is not likely to become effective, particularly in view of the Deposit Bill of 1934 which vests title to the oil deposits in the state. Through the 1934 bill the state exercises some control over the industry through the mining authority without becoming an active operator itself. It is not likely that the state will try to become an active operator in any event since the oil search in Northwest Germany is somewhat expensive and uncertain. Private companies continue their exploration, most having refineries to supply, and some, especially the foreign companies, have widespread marketing organizations.

The industry is now operated by sev-

■ CONTINUED ON PAGE 218

Rig No. 6, Robinson Drilling Co., Fairfield Ill., has two 6-WAKDU Waukesha Diesel Power Units: 6 cyl., 6¼ in. bore x 6½ in. stroke, 1197 cu. in. displ.





SAVES 30% ON FUEL AND LUBRICANTS ALONE *with* WAUKESHA *Diesel* POWER

● Mr. E. B. Young, Supt., Robinson Drilling Co., Fairfield, Ill., checked operating costs of their Cardwell rotary drilling rigs—Diesel vs. Butane. Each unit drilled 5 wells, average depth 3200-3400 ft. Rig No. 6 has two Model 6-WAKDU Waukesha Diesel Units. Rig No. 2 has two same sized engines burning butane. Average actual drilling time per well: butane engine, 1432 hrs.; Diesel, 1384 hrs. A saving of 48 hrs. per well with the Waukesha Diesel. Butane engine used 5351 gal. of butane, costing $520.51 per well. Waukesha Diesel used 2660 gal. of diesel fuel (less than half as much) costing $309.30. Cost of oil and lubricants, per well: butane engine, $187.00; Waukesha Diesel, $128.25. Figuring in gasoline used by Waukesha powered 5KW Kohler light plant on Diesel rig, total cost of fuel, oil and lubricants per well was $483.25 for Waukesha Diesel rig; and $707.51 for butane engine rig. A saving of $224.26 or 30 per cent in fuel and lubricants alone, and 48 hours in time, by the Waukesha Diesel says Mr. Young. And there were no shutdowns due to engine failure with either butane or Waukesha Diesel units.

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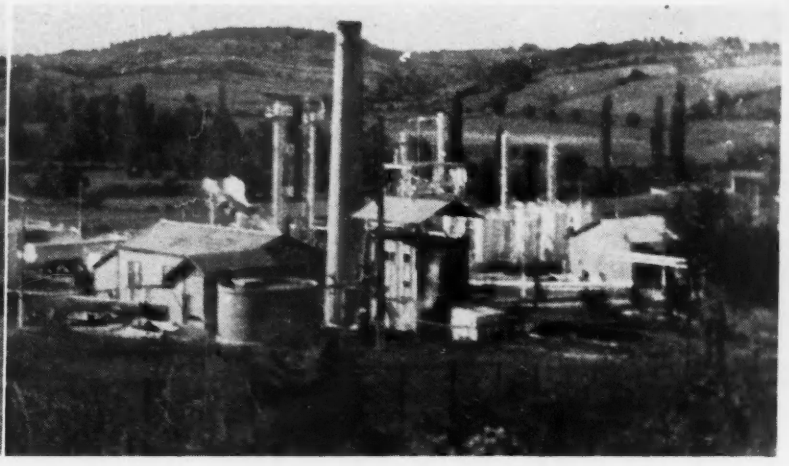
Saint Marcet Field. Gas collection station in foreground.



Absorption plant and compressor station at Peyrouzet.

Saint Gaudens Gas Fields

IMPORTANT TO FRENCH ECONOMY

By E. N. TIRATSOO
Staff Writer

AT SAINT GAUDENS, in the northern foothills of the Pyrenees, Southern France, intensified development of gas production in the Saint Marcet field by Regie Autonome des Petroles is having a definite effect in France's effort to develop a supply of fuel to help fill the growing gap between domestic demand and imports. This demand has been intensified by the progress of rehabilitation, and new sources are badly needed, both to help bolster the internal economy, and because crude oil from other sources is still in tight supply.

An active program of exploration and exploitation of the area controlled by RAP is under way, and although commercial production of crude has not been established, it is geologically possible, according to experts at work on the project, that oil may be found below the gas horizons by deeper drilling with heavier equipment.

Oil production from the south of France is practically negligible, amounting to no more than 30 barrels daily from one well in the Saint Marcet area, but expansion of the gas production has been rapid and steady since 1942 until estimated production for 1947 from this area was approximately 6 billion cubic feet, the equivalent if properly used of 1 million barrels of oil.

Exploration in this area was carried on sporadically by private companies for years, spurred by traces of oil north of the Pyrenees, particularly in the valley of the Adour and in Languedoc. But it was not until 1937, when the French government decided upon a serious effort to find oil here, that anything like a logical program began to take form. A geological commission was assigned to the preliminary exploratory work to select drilling sites, and the "Centre des Recherches du Petrole du Midi" was established with fiscal backing to carry out actual drilling operations. A well was spudded in October, 1938, at Pic Saint Loup, 15 miles north of Montpellier, and another was started in January, 1939, at Pinat, six miles north of Saint Gaudens. This was the discovery well of the St. Marcet gas field. At the beginning of the war rigs were brought in from the African colonies to speed up exploitation of the field, and early in 1941 the CRPM was superceded by Regie Autonome des Petroles, which was given the task of exploring and developing a concession of 245,000 hectares (505,395 acres) bounded at the four corners by the towns of Lannemezan, Mirande, Le Fossat and Montesquieu-Avantes. Since then concessions have been let to two other ogranizations for prospecting in the general area. Both own considerably more acreage than is included in the Saint Gaudens block, but on neither has any commercial production been developed. RAP, although 100 percent government owned, is the only one which is self-supporting and not dependent upon government subsidies.

Geologically, the area lies in the foothills zone of the Pyrenees and there are consequently a succession of typical foothill zone anticlines striking generally east-west parallel to the mountain range. Sedimentary conditions have not been found too good in the Languedoc area or to the west, so the search was concentrated in the middle zone where the destruction of a pre-Cambrian massif had resulted in the deposition of porous beds covered by more than 3000 feet of impermeable marls showing well-marked surface structures in the Eocene and Upper Cretaceous.

The first well drilled on the Aulon-Saint Marcet fold found high-pressure gas in a dolomitic breccia of Middle Cretaceous age, went on down and found a small amount of high-quality oil in Jurassic dolomite at 5500 feet which had poor porosity. About 20 barrels of oil daily were obtained from this well for a short time, and it was carried down to 7000 feet and abandoned in Triassic anhydrite.

Subsequent drilling on this structure revealed the fold to be anything but simple, it having a diapyric geologic cross-section somewhat similar to many Roumanian structures. Structural complexity, stratigraphic unconformities, varying porosity in the Jurassic reservoir formation, and drilling difficulties have slowed development and no commercial

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oil production of any magnitude has been found. The Saint Marcet 11 produces about 30 barrels daily from Jurissic dolomite at about 5400 feet with production being sent by tank car to the Frontignan refinery south of Montpellier.

A broad zone in Southwestern France contains many upthrust Triassic plugs injected into the overlying sediments, and it is possible that deeper drilling will find underlying salt masses analogous to those in Roumania and on the Texas Gulf Coast.

The Saint Marcet anticline is continued to the east in the Proupiary and Saint Martory domes, the three uplifts together forming the present productive area of the concession, and to the north lies the Aurignac-Plagne-Richou axis with its westward continuation at Gensac. Still farther north is the line of folds through Puymaurin, where a deep test now being drilled has gone to 11,000 feet.

There are now ten rigs running on the concession, nine of which are operated by RAP, with the other owned by an independent French drilling contractor. Three of the rigs are kept busy on exploitation work at St. Marcet, while two more are working on the Proupiary and Saint Martory structures. One heavy duty rotary rig is drilling the wildcat at Puymaurin which had reached 11,000 feet when last reported. At this point it was in the Jurassic formation, which yielded showings of gas and oil, but also water. It was scheduled for 12,000 feet.

Seven Producers

Although 19 wells have been drilled in the Saint Marcet field, production comes from only seven wells, of which three . . . Saint Marcet 5, 6 and 7 . . . still furnish 90 percent of the production. As previously mentioned, the only oil producer is the No. 11 well.

Drilling is both slow and difficult in this part of France, for several reasons. The formations are hard, mostly limestone with steep dips, so that wells tend to go off vertical if much pressure is used. There are also several zones of high-pressure gas which have to be carefully handled. (St. Marcet 4 caught fire and burned for two months.) It takes an average of almost a year to drill 9000 feet, although this slow rate is partially the result of the general shortage of drilling material. Rock bits are used almost exclusively, and during the war the French had to manufacture their own. Now they use as many American bits as can be imported, although some French bits are still in use.

While the large sizes of French and American bits give similar performance, it has been found that American bits in small sizes drill about twice the footage of the smaller French models.

The drilling rigs are all rotaries and five are American, one being diesel driven and four electric. There are two German rotaries in use, left behind by the German occupation forces, who used them to drill three shallow dry holes (Gensac 2 and 3 and Plagne 2) in 1944. The contractor is also using a German-type rig. One French-made rig is being employed, and one portable rig of American manufacture.

In addition to the deep well at Pymaurin, four other wildcats are being drilled on the concession. This includes a geological test being drilled at Saint Planchard, southwest of Saint Gaudens. The wildcats are Aurignac 3, on an exposed structure, now at 3450 feet and still in the Upper Cretaceous. It is expected to continue to 12,000 feet or deeper in search of information on the Jurassic. Two previous wells on this structure were dry.

Plagne 3, on the structure southeast of Aurignac was drilling below 9600 feet in the base of the Upper Cretaceous with no showings of commercial importance found as yet. The first two wells drilled on this structure have had showings of gas, but were not commercial.

Richou 2, southeast of Plagne, is below 3600 feet and still in Upper Cretaceous. The first well was abandoned after finding formations almost vertical.

Drilling in 1947 has resulted in more

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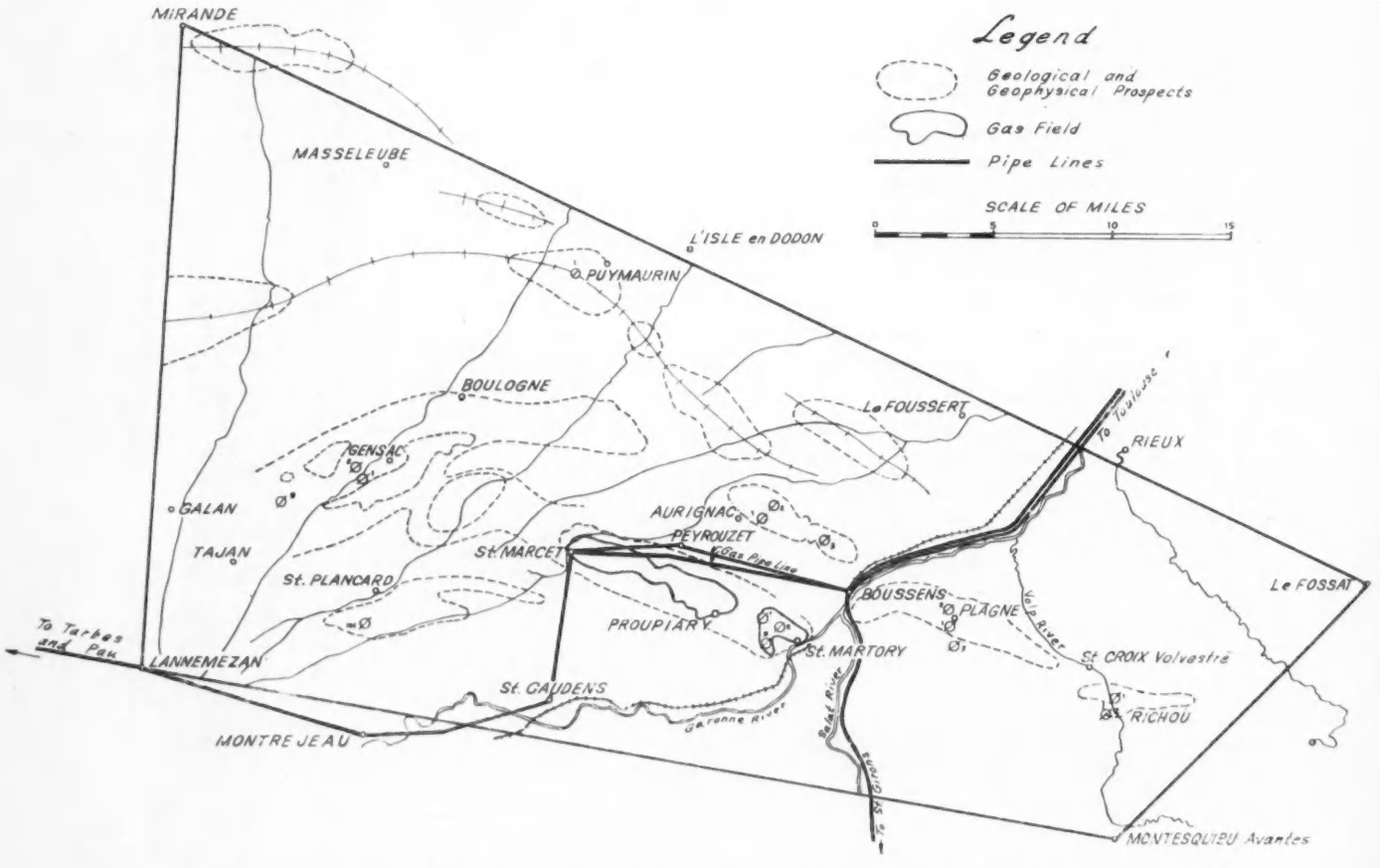


Regie Autonome des Petroles concession, showing location of structures being developed and prospected.

Mexico's NEED FOR NEW RESERVES

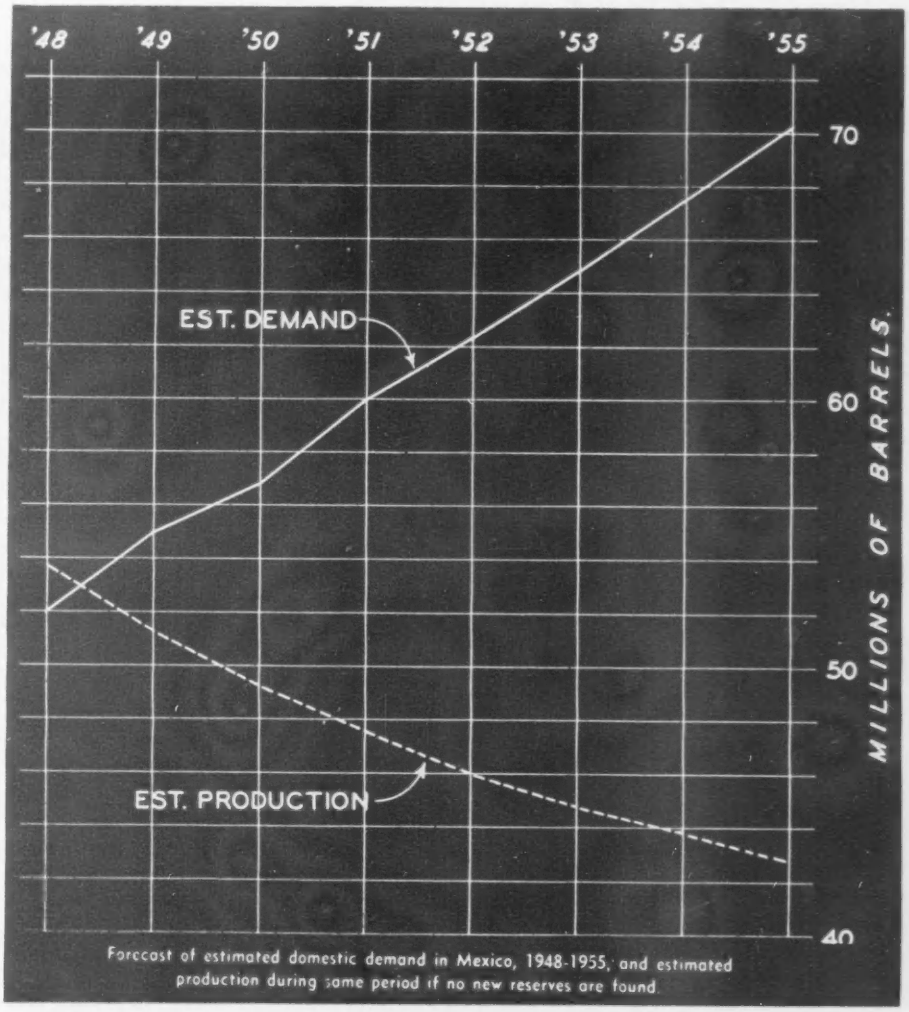
THE alarming possibility that Mexico will not be producing enough crude to meet its domestic demand unless new reserves are found before 1950 was aired recently in Mexico City.

Speaking before the third annual convention of the exploration department of Pemex on January 6, Jorge L. Cumming, assistant chief of the Pemex exploration department, declared in his keynote address: "The situation is clear; the production of crudes will not serve to cover the minimum demands of the national market in a dangerously near future . . . unless new reserves are discovered and immediately exploited."

Cumming made no attempt to minimize the gravity of the situation in its relation to Mexico's oil economy. He stated that research by Pemex experts places estimated reserves for the nation at 1,058,000,000 barrels. Taking into consideration the theory that reserves should be 20 times the amount of the annual production, he pointed out that Mexico's estimated 53,700,000-barrel production during 1948 will be just about at the safety limit, and that production henceforth will decline to the point where presently proved reserves will allow a production of no more than 43 million barrels by 1955.

Meanwhile, the best estimates of climbing domestic demand in the nation, as illustrated by the chart, show that requirements by 1955 will be something more than 70 million barrels yearly. By mid-1949 the rising domestic needs will just about balance the declining field output, and it appears that by 1950 Mexico will no longer be a net exporter of crude or products. Cumming named 1950 as the critical year, when it is expected that the domestic demand will be 56,800,000 barrels, while production, unless new reserves are found, will have declined to 49,300,000 barrels. The gap must be filled in by production from new oil fields.

Applying the ratio of 20 barrels reserve for every barrel which may efficiently be produced annually, the following compilation was made to show the required new production each year over and above the estimated output to be drawn from presently known reserves, and the amount of newly discovered reserve necessary to support the additional new production.



Forecast of estimated domestic demand in Mexico, 1948-1955, and estimated production during same period if no new reserves are found.

Year	Required New Production	Reserves at 20-1 Ratio
1949	... 3,700,000 bbls.	74,000,000 bbls.
1950	... 7,500,000 bbls.	150,000,000 bbls.
1951	...12,400,000 bbls.	248,000,000 bbls.
1952	...16,300,000 bbls.	326,000,000 bbls.
1953	...20,000,000 bbls.	400,000,000 bbls.
1954	...23,700,000 bbls.	474,000,000 bbls.
1955	...27,400,000 bbls.	548,000,000 bbls.

In studying the petroleum possibilities of Mexico, and considering the intense petroleum developments which have been carried on in the U. S., Cumming thinks that results of exploratory drilling at this time in Mexico should be about three times as successful as in the U. S. He said Pemex would drill 75 test wells this year with the help of American crews and experts, and would continue to drill this number of wildcats each year, indicating the belief that this amount of wildcatting would suffice for finding enough reserve to meet Mexico's needs and furnish a balance for export. He placed cost of such a program at $5 million (U.S.) annually for the necessary geological and geophysical work required to locate structures and make locations, and an additional $12 million (U.S.) for the actual drilling expense.

His forecast program is based on the premise that each successful exploratory well should account for the discovery of 18 million barrels of reserves, or about three times the results now being obtained in the U. S. Further, his forecast requires that each year's exploratory pro-

gram of 75 wells results in the discovery of at least four such 18-million barrel fields. This is merely a projected rhythm of discovery, but serves to reflect the enormity of the task being faced by those responsible for development of Mexico's petroleum resources.

The expectancy of finding three times as much oil with each discovery as is found in the U. S. is based simply on the fact that past exploration has been extremely limited, and that exploration can be expected to pick up the better fields first. Actually, only a small percentage of Mexico's favorably located territory has been tested by drilling. The meeting had scheduled for discussion the possibility of finding new oil deposits in the northeast Tampico region, Isthmus of Tehuantepec, and other regions so far unexplored in Lower California, Chihuahua, Coahuila, Yucatan and Veracruz states.

Further need for finding oil in quantities sufficient to leave a surplus for export were pointed out by Cumming in calling attention to the fact that exports are needed to ease an unfavorable trade balance, and protect a dwindling dollar balance.

Germany Looks to Emsland

• CONTINUED FROM PAGE 210

eral private companies, both German and foreign owned, in addition to several companies whose shares are owned principally by the state.

Table I shows principal operators by the above classifications together with the proportionate share of each in producing operations:

Top Private Concerns

The three top places in production are taken by three privately-owned German concerns, the Gewerkschaft Elwerath company being the largest single producer and owning about 70 percent of the output from the Nienhagen field. It owns other production at Lingen, Wesendorf, Hohenassel and Georgsdorf.

Most of the Deutsche Erdoel production comes from the Wietze field where it operates mine shafts and wells. It also operates at Heide, Wesendorf, and several smaller salt dome type fields.

Wintershall, now in third place, is in perhaps the best position of any of the companies, since it owns 100 percent of the new Emlichheim field on the Dutch border which is Germany's most significant discovery. The company also discovered and operates in Fuhrberg, Eicklingen and Meckelfeld.

Deutsche Vacuum Oel, one of the American-owned firms, has most of its production in Nienhagen field where it owns production on the south flank of the dome, the Reitbrook field near Hamburg, and Oberg, southeast of Hanover. It also discovered and operates the small field at Hademstorf. The company's exploratory campaign was brought to a standstill by not being able to obtain any new concessions during the war, but it is now drilling exploratory wells on concessions in Oldenburg, Schleswig-Holstein, and Hanover.

The Gewerkschaft Brigitta firm, owned jointly by Shell and Standard Oil Company (N. J.) derives 96 percent of its production from the Steimbke-Rodewald field, but also owns properties at Fuhrberg and Thoeren.

The state-owned companies are commercial entities, being run by employes and not by officials. The Preussag is an old mining company which entered the oil industry in 1930, and was instrumental in discovering several fields, including Reitbrook, where it owns a considerable portion of the production. The decline of output from this field has affected the company's position materially.

The Schactbau- & Tiefbohr-Gesellschaft company drilled the first oil well in the Emsland, at Lingen-Dahlum, now owning 50 percent of the output from that area.

Saint Gaudens Gas Fields

• CONTINUED FROM PAGE 214

footage than in any year since work started on the concession. It was estimated that 1947 would see a total of 58,700 feet of hole drilled, a gain of 50 percent over 1946, which was in turn 63 percent more than 1945. To the end of 1946 there had been a total of 187,200 feet drilled on the concession. Footage per rig has shown a material increase due partly to an increase in the quantity of available materials, and to the resumption of Sunday shift work which had been abandoned during the German occupation.

Since discovery of commercial gas in the Saint Marcet field, the area has produced 11,134,666,800 cubic feet with present production from seven wells, one of which is a control well. Reservoir pressure originally stood at 2275 pounds per square inch, and there has been very little drop in spite of the recent large scale production. It is processed through an absorption plant at Peyrouzet which has a capacity of approximately 10 million cubic feet daily operating on a simple gas-oil absorption cycle, and which also stabilizes the casinghead gasoline from the field separators. It now operates at about 325 pounds per square inch, but by doubling this the throughput of the plant can be raised to about 42 million cubic feet of gas daily. The gas then goes into pipe lines for distribution to industrial centers in the area. Composition of the gas is 92 percent methane, 4 percent ethane, 1½ percent propane, 1¼ percent butane and the same amount of higher homologues. The absorption plant itself was built by Compagnie Francaise de Raffinage, which company operates it for the RAP since its installation in 1942.

Pipe lines are now in operation connecting the field with the towns of Pau, Tarbes, Boussens and Toulouse. At the beginning of 1947 there were 135 miles of 4-, 5½- and 6-inch line in service with another 105 miles planned for the year, much of which has been constructed on schedule. In addition plans now call for a 150-mile line from Toulouse to Bordeaux to be built of eight-inch pipe.

Methane gas is used in the area for a number of industrial purposes, and a small carbon-black plant was installed at Peyrouzet during the war as an experimental venture. Much use is made of it in the chemical industries of Southern France, and in addition much is compressed into cylinders for use as motor fuel. There are about 7000 motor vehicles in France which run on methane.

Deep Tests Planned

Future plans of the RAP include drilling of a series of deep wildcat tests during the next two or three years over the whole area of the concession in an effort to find commercial oil production. It is also proposed to turn attention to two other areas in France where concessions have been applied for. The first of these is in the northeast Jura Basin where a shallow gas well drilled for the government at Refigny has given some production from the Triassic. The second area is in the Luberon region east of the Rhone River, where it is hoped there may be accumulations in the Jurassic or Triassic. Geological and geophysical work will be started in both these areas during this year.

Acknowledgement is made to J. H. de Vries, General Manager of RAP for cooperation and courtesy shown in gathering data for this article. M. de Vries, a graduate of the Ecole Polytechnique in Paris and Petroleum School at Strasbourg, got his early oil training in the U. S. in 1925 with the Carter Oil Company, spent some months with Scottish Oils, Ltd., in the Grangemouth oil shale area, and then went to Roumania with Romana-Americana company after which he spent some time in Venezuela and with a French geological survey in the Cameroons. He was placed in charge of the oil exploration in France itself in 1937.

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RUSSIA MAY DOMINATE

One-Third

OF ULTIMATE WORLD RESERVE

By F. JULIUS FOHS,
Geologist

THE purpose of this study is to give a picture of present and ultimate oil possibilities of the USSR so they may be compared with those of the U. S. After outlining source material for the study, a general picture of the structure and tectonics of Eurasia and Siberia is given as the background to distinguish oil-bearing from oil-barren regions. The oil and gas deposits occur in reservoir beds similar to those familiar in the U. S. from Devonian to Pliocene strata, inclusive, with prospects that Silurian and Ordovician will also produce, with a small amount reported from Cambrian beds. The structure and stratigraphic types of occurrence are also similar. Then a more detailed picture of each possible oil region, both productive and prospective is presented, with a comparison of their relative merits.

Of 8,390,000 square miles of land-inland sea area within USSR boundaries, 3,600,000 square miles have greater or less possibilities for finding and production of oil; and in addition there are 400,000 square miles of continental-shelf area within the 200 meter depth limit. Of the total possible area, 1 million square miles classify as younger marine sedimentary (Cretaceous to Pliocene) deposits.

Production to beginning of 1947 in USSR, inclusive of Sakhalin, was 5,722,000,000 barrels; in 1946 it was 166 million barrels, two-thirds of that of 1939. Total production in the U. S. was 34 billion barrels, while that in 1946 was 1,754,000,000, about 50 percent more than that of 1939.

Total estimated proven reserves of the Soviets are close to 8 billion barrels, while those of the U. S. are 24 billion barrels.

While the USSR has barely begun development, having only 12,000 oil wells, that of the U. S. is well advanced with 424,000 producing wells. It will therefore require a long period of time, large capital investments, much of machine tools and other machinery to adequately develop the Soviet possibilities. They are 30 years behind the U. S.

Exploration and development in the Soviet Union is being carried forward with latest techniques developed in the U. S. and elsewhere, with some new Soviet methods as well.

Affiliates' Possibilities

The affiliated countries under Soviet control are Roumania, Hungary, Czechoslovakia, Yugoslavia, Albania, and Poland, which cover a surficial area of 427,000 square miles. These include two important basins, the Hungarian and Roumanian inclusive of the Sub-Carpathian region, which covers 130,000 square miles of prospective territory, with the Roumanian district much more important. The proven reserves are of the order of 241 million to 491 million barrels, with estimates for Roumania ranging from 150 million to 400 million barrels. Production to date has been 1,459,000,000 barrels, and during 1946 it is estimated as 44 million barrels. It is down 25 percent in Roumania due to the last war, but the possibilities of developing important new production is considerable as the Roumanian basin is one of the best in Europe and similar in type to our Gulf Coast. The USSR has been getting 95½ percent of the Roumanian output because of its great need for oil, but it is reported that some of this is to be released shortly, perhaps to other East European states now that the U. S. has ceased exporting oil to them. Outer Mongolia and Tannu Tuva, also affiliated, have little or no oil prospects.

Lewis G. Weeks' estimate of U. S. sedimentary basins exploitable for oil is 1,400,000 square miles to which he gives an ultimate estimated production of 100 billion barrels.

Comparing Soviet areas in kind with those given by Weeks for certain U. S. regions, and allowing for average depth of favorable sedimentaries in each basin judged by available data, I obtain for the USSR the following figures inclusive of land and continental shelf:

For the more important districts, namely Moscow-East Russian basin, pre-Caspian and extensions, Transcaspian, South Caucasus and East Sakhalin, I estimate a total area of 1,805,000 square miles with sedimentaries totaling 2,736,000 cubic miles and having an oil-gas content of 162 billion barrels. Additionally of much more speculative character, some 1,650,000 square miles with an estimated total of 1,708,000 cubic miles of sedimentary rocks may yield an ultimate of 33 billion barrels. Of this only 6 billion have been produced and about 8 billion proven, leaving the balance to be found and developed, a truly stupendous task, although a large number of mapped structures await adequate testing.

It appears likely and reasonable, therefore, to conclude that the Soviet Union has within its own borders an ultimate oil reserve of at least 150 to 160 billion barrels and it may conceivably approach 180 to 190 billion barrels. Allowing for areas under Soviet control, it is clear that the USSR dominates over one-third of the total ultimate oil reserve of the entire world.

Soviet Russia has ample other power resources. It is second to the U. S. in coal reserves. It also has abundant oil shale deposits, which as well as the coal may be converted to oil and gas as required. Its hydroelectric power possibilities are very large. Development of coal has been considerable; there has been some development of oil shale for both oil and gas production; and while hydroelectric development has barely begun, construction of 15 million kilowatts is planned. Of its atomic energy minerals, ample territory favorable for their vein occurrence exists in its large pre-Cambrian and shield areas; in addition, Eklund estimates 1 million tons of ordinary uranium extractable from Soviet oil shales and states the U. S. has a like amount, as does Sweden. The Soviets are resources rich, but development poor. This emphasizes how very great is the Soviet need for a long period of peacetime development of its great power resources, whereas the U. S., through its combined individual, corporation and government effort, has reached a greatly advanced stage. Both countries can with continued development be self-contained as far as power resources are concerned for centuries to come.

From a paper presented by F. Julius Fohs before the Eastern Section of the American Association of Petroleum Geologists December 10 at New York. The full paper is to be printed soon in the Bulletin of the AAPG.

IS VITALLY IMPORTANT IN CEMENTING

STURDY, SIMPLE CONSTRUCTION

The assembly of Baker Model "B" Casing Centralizers (Product No. 910) consists of only three kinds of parts—Collars, Springs, and Stop Rings. Two Collars (positioned at each end of the Centralizer) hold the Springs in place and space them properly. The Collars are *not attached* to the casing, and the Springs are not welded to the Collars. The Springs are held in position by spacer lugs having slots or notches between them, and the turned down ends of these lugs hold the Springs in place. The Springs, which bear the brunt of the load, are formed with a hook at each end, and are made of 3/16" by 1½" spring steel, shaped in a bending die and heat treated to secure ample strength combined with maximum flexibility.

Stop Rings (one at each end) are the *only* parts of the Centralizer attached to the casing, each Stop Ring being plug-welded to the string at four points. The ends of the Springs are hooked over the Stop Rings, and Springs and Collars are left free to turn on the casing.

SAFE, POSITIVE OPERATION

Figure 1 (opposite page) shows the Stop Rings (1) plug-welded at (2) to the casing, with sufficient space left between Collars and Stop Rings (at 3) to permit the maximum elongation of the Springs, even if they were compressed tight against the casing.

Figure 2 shows the casing being run into the hole with the lower Stop Ring engaging the hooks on the lower ends of the Springs (4) and PULLING the Centralizer through the hole (or casing)—NOT PUSHING it through. When a restriction (5) is encountered, the Springs *compress uniformly* and elongate in an upward direction, moving the top Collar towards the upper Stop Ring (6). During the downward travel of the casing, the upper Stop Ring is never in contact with either the Collar or the upper hooked ends of the Springs, so that this upper Stop Ring is unable to exert on the Springs any PUSHING force that would tend to buckle or distort them.

If the casing has to be raised for any reason, the above action is reversed, and the Centralizer assembly is PULLED (rather than PUSHED) *up the hole* and past any restriction.

You will find the Baker Model "B" Casing Centralizer illustrated and described on Pages 366 and 367 of the 1947 BAKER (or Composite) CATALOG. Technically minded operators should read Baker Broadcast No. 21, which contains details of field applications and engineering details on this important equipment. Any "Baker Man" or Baker office will be glad to deliver *your* copy.

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THESE FACTS ARE INTERESTING

Note in Figure 3, below, how casing hanging vertically in a slightly off-vertical hole, results in a dangerous condition for successful cementing. Contact points at A and X prevent proper encasement of the pipe with cement slurry. The illustration next at right shows how a Baker Casing Centralizer near the shoe, and another one up the hole, provide the desired uniform annulus to permit placement of the predetermined thickness of cement all through the critical area.

Figure 4 shows casing extending through an intermediate oil zone that is to be protected by cement both below and above the productive sand. Although the hole is deflected only slightly from vertical, danger points exist at X and Y because a uniform sheath of cement around the casing cannot be secured. How Baker Casing Centralizers overcome this condition is shown in the view at right, Figure 4.

Figure 5 shows how Baker Casing Centralizers provide properly centered casing on a C.P. job, and insure the effectiveness of a Baker Metal Petal Basket by allowing its spring-backed petals to contact the formation evenly.

Figure 6 shows how Baker Casing Centralizers are used to center the casing at critical cementing points and provide the best possible conditions for successful squeeze jobs and other remedial work with Baker Cement Retainers. The interesting details of this job are included in the Baker Casing Centralizer Broadcast which will be sent promptly upon your request.

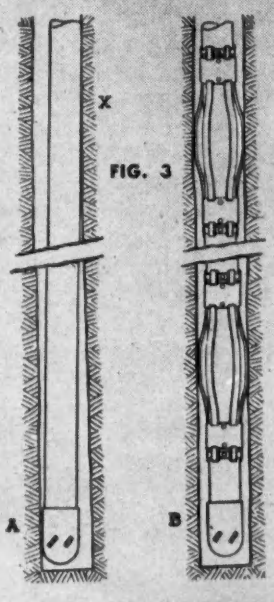


FIG. 3

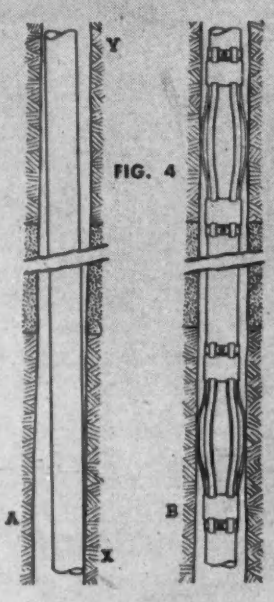


FIG. 4

FIG. 5

FIG. 6

Palestine Partitioning

ENDANGERS MIDDLE EAST PIPE LINE PROGRAM

By HENRY OZANNE

COMPLETION of the whole Middle East pipe line construction program has been delayed—and might collapse—because of the political crisis created by the plan to partition Palestine. These developments confirm the prediction (WORLD OIL, November, 1947, page 252) of the dangers that petroleum interests are up against throughout the Arab world. Already, increasing active Arabian belligerence has completely disrupted work on pipe line projects of British and American oil companies for an indefinite period.

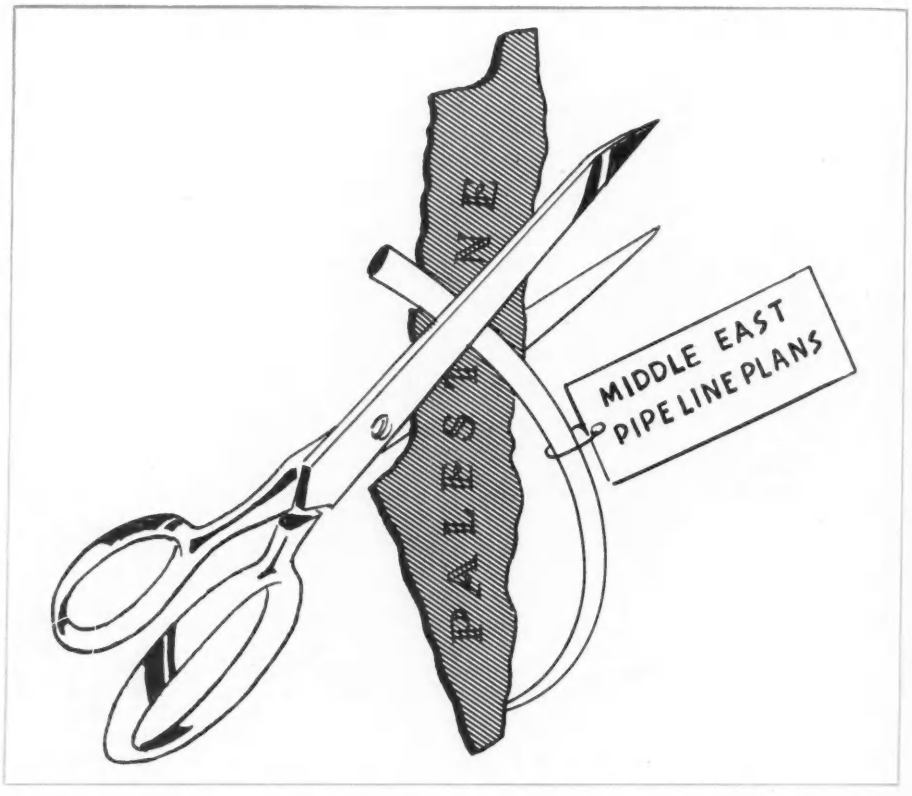
This means the world shortage of oil is to exist longer than heretofore thought probable.

Palestine is in such a state of economic chaos due to the partition dispute that Iraq Petroleum Company is planning to stop work on its new 16-inch line (Kirkuk to Haifa) at the Palestine border. Already the IPC camp at Mafraq, Transjordan, has been raided by Arab tribesmen, and the whole contingent of British-American personnel was forced to flee for their lives.

This line was scheduled for opening late in 1949. Even if the political trouble does not cause further delay, late spring of 1950 now is the earliest possible completion date for this 90,000-barrel per day line. How much longer the completion of the line will actually require depends entirely on the very uncertain political prospects.

Iraq Petroleum has no definite plans for starting construction on its proposed 90,000-barrel per day capacity pipe line from Kirkuk to Tripoli, Lebanon. The company's available pipe is strung along the southern leg, Kirkuk to Haifa line.

Trans-Arabian Pipe Line Company, affiliate of Arabian American, has been forced to discontinue work in Syria, Transjordan and Lebanon. Construction on the 1030-mile, 300,000-barrel daily line from the Saudi Arabian fields to Sidon, Lebanon, has been suspended and employes evacuated to Beirut for safety. Future work hinges largely on the company receiving a green light from the Syrian Parliament. The Syrians have so far withheld transit rights for the line in retaliation against the American position in support of the Palestine partition. Any favorable action from the Syrian Parliament may be delayed as long as the U. S. backs partition. Actually, the Parliament will not meet until March 31, anyway, so the company is the best part of a year delayed in the work with prospects for complete stalemate as far ahead as can be seen.



Middle East Pipe Lines, Ltd., to be owned jointly by Anglo-Iranian, Standard Oil Company (N. J.) and Socony-Vacuum Oil Company, has not yet opened negotiations with the Syrian government for transit rights, and negotiations probably will not be initiated until Trans-Arabian's difficulties with Syria are resolved. This puts the Middle East pipe lines program back in a mere project stage.

European recovery plans, such as the Marshall Plan, assume a pipe line distribution system from the Persian Gulf to the Mediterranean in operation by 1952. The whole pattern of oil distribution across three continents has been predicated on production and movement of oil from the Persian Gulf producing areas to the Mediterranean at rates upward of 1 million barrels a day. It is now conceded that this transportation figure will more likely be of the order of 200,000 barrels daily . . . and only that much if Iraq Petroleum Company succeeds in completing the south leg of its new system by that date.

Meanwhile, the equipment shortage problem, which was paramount before the political issue took first place, further complicates the situation. There are only two companies in the world that can roll 30-inch pipe or larger in adequate orders for such programs as were planned in the Middle East. The mills are back-logged. For the projected 3000 miles of total lines of all interested companies, a mill rolling at the rate of three miles a day would, even on uninterrupted operation, require about three years to turn out the pipe. Even with no political complication, it would be an impossible time-schedule to open the lines by 1952.

Industry executives in the know are taking the attitude . . . when asked concerning time schedules . . . "wait and see when—if ever." And all agree that the full impact of Arab resistance is still to come.

Canada's Leduc Field Grows In Importance

ACTIVITY set off by the important Leduc discovery early in 1947 has resulted in a field of major importance to the petroleum economy of Canada.

Latest discoveries are assurance of gas-distillate production in two areas, although the wildcats expected to become the pool openers are still drilling ahead and testing, and may possibly find production of crude before finally being completed. One of the areas is being opened by Canadian Gulf Oil Company in the Foothills area at Pincher Creek, and the other is by Imperial Oil Company, Ltd., northwest of the Leduc field.

The Woodbend discovery by Imperial came just 11 months after the completion of the first well at Leduc. Its most recent test was a drill-stem test at 5265-95 feet where it flowed gas at the rate of 2,800,000 cubic feet daily, and recovered a drill stem full of 40-gravity oil which reached the surface in 15 minutes. The source of this oil and gas corresponds to the D3 zone in the Devonian, the same source as that from which comes the major portion of the oil at Leduc. Previous tests as high as 5238 feet showed gas in quantities considered commercial, and have also some condensate, but this most recent test is the first indication of crude. The well continues coring and testing before setting casing for completion.

It is in the township north of that which contains the Leduc field, and about 3½ miles northwest of Globe-Leduc's West 4, the most northerly producer in the Leduc field, but is reported running just about level on top of the gas zone with the top of the gas cap at Leduc. The Globe-Leduc West 4 ran 54 feet lower on gas sand than the closest well to the south and about 100 feet lower than others to the south and east, indicating a low area between the north end of the Leduc field and the new Woodbend well which gives rise to its classification as a discovery rather than an extension to the Leduc field. Drill-stem tests previous to the one which recovered crude showed gas at rates as high as 6 million cubic feet daily on the basis of short tests.

Leduc, discovered in February of 1947, has a proved area of about 8100 acres, and has a proved reserve estimate ranging from 80 million to 120 million barrels. It is producing from two limestone and dolomite formations in the Devonian, the D2 coming in at around 5000 feet and the D3 from 5200 to 5300 feet. So far more than 35 wells have been completed, with initial production ranging from 500 barrels to more than 2500 barrels daily. Under a temporary conservation policy, pending further investigation of reservoir conditions in the field, D2 wells are being operated at 100 barrels daily, and D3 wells at 150 barrels. Development is proceeding rapidly due to its strategic location with respect to demand centers, with Imperial operating 12 drilling rigs and other operators running ten more. Still other drilling equipment is scheduled for the field in February and March. Drilling time on these wells ranges from 25 to 45 days each.

Canadian Gulf's discovery at Pincher Creek, known as Pincher Creek 1, has recorded the highest formation pressure yet found in Canada in testing deep formations of highly porous Madison limestone at 11,755-800 feet. Top of the Madison was found at 11,700 feet and the well then drilled an additional 100 feet before setting the seven-inch casing at 11,755 feet. A drill-stem test was made in open hole with pipe loaded with a 3312-foot water cushion. When the tool was opened the water cushion flowed out in eight minutes. It was allowed to blow for seven minutes, gas flow being estimated at 10 million cubic feet daily and flowing pressure rising to 3200 pounds. In five minutes, after closing the tester the pressure built up to 5775 pounds, about 1800 pounds higher than the former Alberta records at Turner Valley and Jumping Pound. Recovery in the drill stem amounted to 165 feet of fluid, of which ten feet was gas-cut mud and 155 feet was amber-colored light oil with gravity estimated at 47 to 50 degrees.

Following a series of velocity surveys, Gulf resumed coring for a further look at the section and in mid-January was coring at 11,838 feet.

This is the first well drilled in Canada on the strength of refraction seismograph work. The Madison lime was reached at a depth very close to the estimate made before drilling. Located as it is on the mountain front 16 miles north of the Montana boundary, it is likely to have an important bearing on exploration both in Canada and in the Montana foothills region.

Meanwhile, another oil discovery has been reported likely in the Eastern Canadian province of Ontario where Imperial is seeking oil in Tilbury Township. Its well on the Samuel Lynn farm five miles southwest of Tilbury came in flowing six barrels of 38-gravity oil hourly and gas estimated at 300,000 cubic feet daily. Production is from 1169 feet. Imperial states that the discovery is the result of geological work over a period of six or seven years, during which time it has discovered three gas fields and one other oil field. The first oil discovery was at Becher, 2½ miles north of Wallaceburg, where a small field produces 200 barrels daily.

Foreign Exploration Offices Established by Stanolind

Stanolind Oil and Gas Company has established a foreign exploration department. A division ofploratory work in Canada and Colombia, according to E. F. Bullard of Tulsa, president.

Charles T. Jones

Charles T. Jones of Tulsa, has been appointed manager of the new department to conduct exfice will be opened at Calgary, Alberta, and another at Bogota, Colombia.

Jones joined Stanolind in 1934 after receiving his degree in geology from the Missouri School of Mines at Rolla, Mo. He was on the staff of the old Transcontinental Oil Company at Tulsa. Before his appointment as manager of foreign exploration he was manager of Stanolind's Geophysical department.

New Production Mark Set by Canada's Lloydminster Field

The Lloydminster Field, Saskatchewan, Canada, was enabled, through production from the new Lone Rock section of the field, to establish new production records during 1947. Late in the year it was producing at rates of 2244 barrels daily from 67 wells, after having exceeded 1000 barrels daily for the first time in May of 1947.

With complete figures for the year yet to be tabulated it seems certain that the area will show an output of more than 500,000 barrels, which compares with 136,874 barrels in 1946. The Lone Rock area went on production in February and now has more than 12 wells producing 15,000 barrels monthly.

16 Million Barrels Set as Interim Aid Needs of France and Italy Until April

A TOTAL of 16,096,000 barrels of petroleum are set as the Interim Aid requirements of France and Italy for the four-month period December 1, 1947, through March, 1948. The program has been worked up jointly by the Oil and Gas Division of the Department of Interior and the Petroleum Division of the State Department, for presentation to the Senate Foreign Relations Committee.

The figures, which are termed supporting estimates of dollar requirements in interim aid for the two countries, indicate that of the total, only 1,757,000 barrels are to come from the U. S., while 14,339,000 are to be supplied from other "dollar" areas. Quota for France for the period is 10,797,000 barrels, of which 1,415,000 are scheduled from the U. S., and for Italy 5,299,000 barrels, of which only 342,000 are to come from this country. The computation is based on the first half of 1947 requirements for France and Italy and totals four-sixths of their half-year imports.

These requirements are somewhat lower than the 20 million barrel figure given on November 13 to the Senate Foreign Relations Committee. The most recent breakdown estimates by products:

France: Total of six cargoes; one cargo of fuel oil, one of gas oil, two of avgas and two of lubricating oils.

Italy: Three cargoes of lubricating oils, some aviation gasoline and wax products.

In the French requirements are included 700,000 barrels of crude, a figure far out of line with France's present imports, which have been running 12,000 barrels daily, and which would total for the four months interim period about 1½ million barrels. It is pointed out that a number of the French refineries cannot shift to Middle East crude because of sulphur content.

Thus the total dollar value of petroleum items in the $597 million interim aid program is about $40 million, or about 6 percent of the whole bill. However, the Interim Aid plan, like the long-range Marshall Plan itself, contemplates that the bulk of Europe's oil will move from the Middle East and from South America and hence will not constitute an undue drain on U. S. oil resources.

Even the interim aid program does not represent the full petroleum requirements of the countries benefited. About $1 million in oil products will be required for Austria, but that nation is expected to supply about half of her requirements internally. France will be able to obtain other oil outside the aid plan, chiefly through her Compagnie Francaise des Petroles connections in the Middle East.

The Committee of European Economic Cooperation (CEEC) estimates petroleum requirements under the Marshall Plan for the four-year period 1948 through 1951 at $600 million a year average. In volume terms, the 1951 requirements for the 16 nations in the Marshall Plan would amount to 78 million metric tons, or about twice the 1946 imports. Many experts, including members of the House Select Committee on Foreign Aid (Herder) see little chance of meeting such requirements.

The Herder Committee estimates that world petroleum production between 1946 and 1951 will increase by 30 percent, from about 7,900,000 barrels a day (including crude oil and natural gasoline) to around 10 million barrels daily. Increased Middle East production, of which Europe will claim the major part, will probably increase from 700,000 barrels a day to about 1½ million, in the opinion of the Herder experts, "a condition determined not by productive capacity but by the anticipated increase in pipe line capacity."

European consumption of petroleum and petroleum products in 1946 reached 308 million barrels, of which about 20 percent was from European production and 60 percent from the Caribbean and the Middle East. European consumption in 1946 was 12 percent below that of 1938, while U. S. consumption was 70 percent more in 1946 than in 1938.

Cleveland Firm to Construct Pemex Refinery at Salamanca

Arthur G. McKee & Company, Cleveland, has been awarded the contract for design, engineering, purchasing and construction of Petroleo Mexicanos' refinery at Salamanca, Mexico. Construction is expected to start this year and be completed in 1949 at a total cost of $12 million.

The refinery will serve the Salamanca area, and will supply railroads and a projected 30,000-kilowatt power plant with residual fuel oil. The plant in turn will supply the refinery with power. Crude distillation unit, gas-oil thermal cracking unit, treating facilities, Ethyl-blending unit, tankage, shops, offices and warehouses are included in the refinery design. It will turn out residual fuel oil, gasoline and light products.

Papuan Test Below 10,000; Valuable Data Collected

Australasian Petroleum Company's deep test at Kariva, in Papua, is now below 10,000 feet and was still going ahead after having already accumulated much valuable subsurface data.

It has been officially reported that information definitely shows that a considerable area of New Guinea belongs to the geological province known as the Malaysian Arc. This province includes the fields on Borneo, Java and Sumatra as well as the newer fields of Dutch New Guinea.

Present plans include considerable expansion of all types of exploratory work during 1948. Two new rigs capable of drilling to 6000 feet are being moved in and locations have been selected at Oroi near Cape Suckling, southeast of Yule Island, and at Upoia, about 20 miles upstream from the mouth of the Vailala River. The locations were decided upon after detailed geological work.

The 1948 program also calls for a considerable amount of geophysical work in Papua and New Guinea, particularly in the Gulf district of Papua where large areas are completely covered by swamp and alluvium. Gravitymeter and surface magnetometer surveys are scheduled, in addition to possible reconnaissance by airborne magnetometer.

Union Oil's Paraguay Program Little Affected by Revolution

La Paz D-1, Union Oil Company's second wildcat in the Chaco region of Paraguay, now is drilling below 5600 feet. Drilling operations, which had been slowed somewhat during the recent revolution, are back to normal following termination of the internal strife in which government forces regained full control. River traffic, upon which the company is dependent for much of the transportation of heavy equipment and supplies, was delayed at times by the fighting, but other than that no loss or injuries of company personnel were sustained. Airplane transportation was relied upon more heavily during the period of the revolution.

The second well is about 50 miles east from the initial test, Santa Rosa 1, abandoned at 7500 feet without showings of importance. Three geophysical crews currently are testing the region.

Norway Refinery Opened

The opening of a new refinery at Bergen, Norway, replacing the former war-damaged plant, has been announced. Reports from Norway also indicate that an increased petrol tax will be effected in 1948.

Holland Well Spudded

The Netherlands Oil Company, a joint subsidiary of the Bataafsche Petroleum Company and Standard Oil Company (N. J.) was to start exploratory drilling at Delft.

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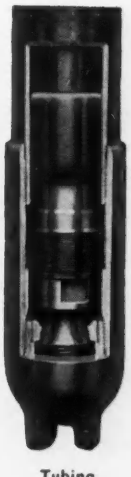

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GUESTS OF HOUSTON NOMADS—Foreign traveling guests of the Houston chapter of Nomads at their January meeting were, left to right, W. H. Burkleo, Halliburton Oil Well Cementing Company, Caracas, Venezuela; E. Paul Hubbard, newly-appointed superintendent of production in the Houston district for Gulf Oil Corporation, who recently returned from Kuwait; Jerry Wharton, Gulf Oil Corporation, New York City, recently returned from England; and Mike McGar, field superintendent for Orinoco Oil Company, Maracaibo, Venezuela.

Fuel-Short Spain Seeks To Discover Its Own Oil

Increasing fuel restrictions in Spain are causing attention to be turned to the possibility of discovering local oil deposits. It is thought that small oil accumulations exist in Castille and Catalonia, and a business association has been formed in Barcelona to sponsor petroleum prospecting in the latter area.

Petroleum exploration has been under way for some time in the Lerida area by the Spanish Compania Espanola de Petroleos in collaboration with Socony Vacuum Oil Company.

A synthetic oil plant planned to produce 700,000 barrels of oil yearly from soft coal or lignite is being built by the National Industrial Institute at Pertollano.

Schoonebeek Fields Yielding 14 Percent of Nation's Needs

Despite a nearly four-fold increase in output for 1947, the Schoonebeek fields of Northeastern Holland, on the German border, are currently producing only 14 percent of the country's domestic requirements.

During 1946 the fields produced 435,420 barrels, and are expected to show an output for 1948 of 1,740,000 barrels. However, the current domestic demand is running around 875,000 barrels monthly, and monthly output of the fields toward the close of the year was approximately 119,000 barrels.

Shell May Build Refinery On Land Bought Near London

An agreement has been concluded between London and Thames Haven Oil Wharves Ltd. and Shell Refining and Marketing Company, by which Shell will buy about 700 acres of land at Thames Haven on the eastern outskirts of London.

Shell is expected to erect a refinery on this land. The contract includes long-term arrangements for the provision by the Oil Wharves Company of considerable tankage accommodation and other facilities, and will be followed by an equally long-term agreement for this company to handle a large volume of refined products.

Progress Made in Rebuilding East Borneo Oil Facilities

Considerable progress has been made in the rehabilitation of the oil industry in East Borneo. The present output of oil from this area is at the rate of 4,900,000 barrels annually, and the refineries are producing about 10,500 barrels of gasoline and kerosine daily. Combined local storage capacity is about 700,000 barrels.

The Balikpapan refinery should be in operation once more by late 1948 or early 1949.

South African Plant to Make Liquid Products from Coal

Anglo-Transvaal Consolidated Investment Company is to start construction soon on a huge plant for the production of liquid products from coal, with the South African government expected to participate in the venture. The plant is to operate on low grade Vaal River coal which is cheap enough so that the product is expected to compete in price with imported petroleum fuels. The South African Torbanite Mining and Refining Company has been operating successfully for about ten years on a process for obtaining fuel from local torbanite, and is now expected to increase its yield to 69 million gallons of gasoline and diesel fuel yearly within the next three years.

The new plant is planned to be somewhat similar to Standard Oil Company of Indiana's plant at Hugoton.

Britain's Fuel Oil Plight Becomes Increasingly Grave

The British Ministry of Fuel and Power has announced that although the coal position is improving, the fuel oil situation is increasingly difficult, owing principally to tanker and railcar shortages.

As a result, the Coal-Oil conversion program of British industry has had to be modified. The present position is that 1277 industrial conversions have been completed out of a total of 2523 authorized, and are now burning oil at a rate of 14¾ million barrels yearly. More than 25 percent of this total has been taken by the steel industry and is expected to result in a substantial improvement in steel output. When completed, the conversion program would consume 40 million barrels of fuel oil annually, and to avoid an oil famine which would otherwise occur, a stop has been made to further industrial conversions for the present.

Like other British industries, shipping is now faced with a restriction of supplies of oil for fuel and much concern is being felt by marine firms at the prospect of bunkering restrictions.

The prospect of immediate shortages of oil products possibly has caused the government's decision to keep the Petroleum Board in being after its advertised date of dissolution on December 31, 1947.

The British petroleum equipment industry is developing fast as a result of the dollar shortage. Figures released by the Oil Companies Materials Committee show that orders placed by the British oil companies for materials and equipment manufactured in the U. K. for shipment to the British petroleum industry overseas during the first nine months of 1947 totalled £33½ millions, or practically as much as for the whole of 1946. However, there are still many items of oil field and refinery equipment either unobtainable or in short supply here.

For the first time in history, rock bits are being manufactured in England. These bits have been tested in oil field conditions in Egypt and Ecuador and large-scale production is now under way.

Philippines Well Reported To Have Tapped Oil Shows

Far East Oil Development Company, Inc., which is drilling a well on northern Cebu in the Philippines, found about 40 feet of oil shows in lower horizons between 7650 and 8275 feet, it was reported. The geological structure is indicated as a dome which is large enough to develop into a fair-sized field.

BETHLEHEM FORGINGS FOR MAKERS OF *OIL FIELD EQUIPMENT*

Typical examples of Bethlehem oil-country forgings are slush pump liners, kelly-bar blanks, and rough-turned, rough-bored drill collar blanks. In addition, we have excellent facilities for making a wide variety of drop, press, and upsetter forgings.

We're old hands at turning out oil-country forgings. During many years' experience, we have developed techniques that mean better, sturdier parts for your products . . . fewer machining and treating problems. They are forgings you can depend upon.

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BETHLEHEM STEEL

Russia's Industry Largely Recovered From Devastation of German Invaders

The Russian oil industry appears to have progressed a long way towards repairing the damage done by the invading German armies during the war, when more than 3000 oil wells producing 36,330,000 barrels of oil a year were destroyed in the Grosny and Krasnodar areas.

Since the beginning of 1947, production from Baku and Grosny fields has increased by 20 percent, and a number of previously abandoned wells have been brought back into production. The total drilling in these areas has been increased by 50 percent since 1945 and an increase of 40 percent on the prewar figures for exploratory drilling is announced.

Petroleum output in the southern and western regions of the Soviet Union in 1947 is said to have exceeded that of 1946 by 16.9 percent. In 1947 the eastern regions produced 2.5 times as much crude and 2.7 times as much gasoline as before the war.

Oil has been found in the Moscow area for the first time, at Kaluga, north of the capital, according to reports. This oil was found at shallow depths in Devonian strata similar to those previously proved productive in the Samara, Kuibishev and Bashkiria regions. Prospecting for natural gas is now proceeding at various places around Moscow including Boravsk, Yasnaya Polyana, near Tula, and in Kalinin Oblast.

A petroleum Research Center has been established under the USSR Academy of Sciences. This center will carry out investigations on the origin of oil deposits in the Soviet Union, and will study improved exploitation methods. Academician Sergei Konetkin has been appointed director.

Dollar Shortage to Affect Oil Industry in Sweden

The Swedish dollar shortage will materially affect the country's oil industry in the near future. Axel Gjoeres, Minister of Trade, has announced that Sweden will buy nearly two-thirds of her imports in 1948 from sterling and soft currency areas, and that imports from hard currency areas will be halved.

Of the total hard currency allocation of 1,455,000,000 kroner, 445 million kroner ($120 million) will be spent on imports of coal and oil during 1948. Gasoline rationing has been introduced, since apart from the dollar shortage a higher proportion of fuel oil must be imported because of recent conversion of industry from coal heating. During the first nine months of 1947, 15½ million barrels of oil products were imported into Sweden, compared with 10 million barrels for the corresponding period of 1946. This increase was mainly due to greater importation of gas and fuel oils.

In view of these shortages the Swedish government is carrying on an expensive prospecting program in the hope of discovering indigenous oil resources. Prospecting is under the direction of the Geological Survey of Sweden.

The Swedish oil shale industry was greatly expanded during the war but still provides only a fraction of the country's fuel needs. Attention has been concentrated in the search for petroleum in the sedimentary area which forms the southwestern portion of Scania, which is Sweden's southernmost province. Between 1938 and 1946 nearly $700,000 was expended in geological and geophysical work as well as exploratory drilling in this area, and the deepest hole drilled was about 6000 feet. Oil traces were found in certain horizons although there were also a number of salt water bearing beds and results were considered sufficiently encouraging for a further $800,000 program to be embarked on in June, 1947. Drilling is being undertaken to explore the brine and solid salt deposits as well as for possible accumulations of oil.

USSR Claims Most of Austria's Output

Following the breakdown of the London conference the USSR is reported to be claiming two-thirds of the Austrian oil production, all reserve stocks of oil, and 75 percent of the refinery plants in Austria. The Russians also claim the right to further research and exploitation of any findings of oil or gas, 75 percent of all the property of the Danube Navigation Company, and about 300 industrial plants. The prices of all oil products sold by the Soviet Control Orop concern are to be raised 150 to 180 percent. This would be a breach of the Allied agreement that the prices of indigenous products should be fixed by the Austrian government. Oil product prices were raised between 80 and 100 percent last August in accordance with the Austrian Prices Law.

Poland's Production Gains; Imports from Russia Heavy

Poland's output of crude in October was 84,061 barrels, and 5700 barrels of casinghead gasoline were produced. The natural gas output amounted to 484 million cubic feet. About 15,000 feet of hole were drilled during the month, and a large quantity of potash salt was discovered at Klodawa near Kolo.

The synthetic fuel plants at Kedzierzyn and Blachownia are being rebuilt and with the synthetic fuel plant now under construction at Nowy Dwor, near Oswiecim, will constitute the first large Polish synthetic fuel combine.

The refinery output for September was 137,258 barrels of finished products, including 2030 barrels of greases.

In spite of the increase in indigenous production, Poland is still importing considerable quantities of foreign oil. During September 54,540 barrels of liquid fuels and lubricating oil and 225 million cubic feet of natural gas were imported from Russia; 21,233 barrels of synthetic gasoline were imported from the Soviet zone of Germany; 6097 barrels of engine oil came from Great Britain; and 350 barrels of transformer oil came from Belgium.

At Grybow in Silesia there are considerable oil shale deposits, the exploitation of which will shortly begin. This shale has a 20 percent bitumen content and it is expected that one cubic foot of shale will yield up to ten pounds of bituminous products.

After five weeks' negotiations, agreement has now been reached with Poland on principles of compensation for British claimants under the nationalization law of January 3, 1946, which affects the whole oil industry. A mixed Anglo-Polish commission has been set up to facilitate further work but no details of the agreement have been disclosed.

Purchased by the Gdynia-American Line from the U. S., the "Turnia," which recently sailed from Manchester for Gdansk, is the first tanker to be owned by Poland. It is reported that two other tankers have been purchased by Poland and are under repair in Gdansk. One, the "Karpaty," has a capacity of 60,000 barrels.

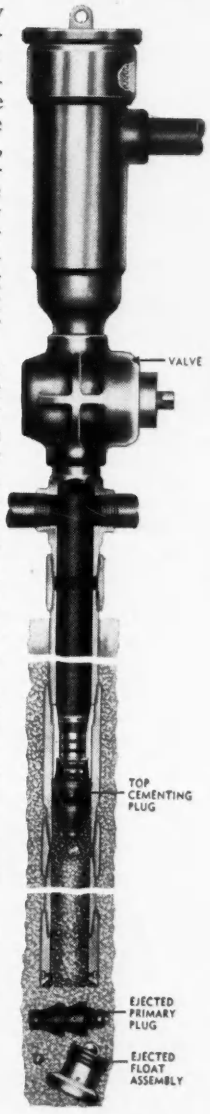
Italy to Make Drill Pipe

Royal Dutch Shell is reported to have made an agreement with the Dalmine steel and pipeworks in Northern Italy (one of the Finsider group) whereby drill pipe will be manufactured in Italy for export to the Netherlands Indies oil fields. The Italians will be paid in the form of scrap steel and oil products.

NEW EQUIPMENT and Literature

1—Two-Plug Cementing Method

A revolutionary improvement in casing cementing makes possible full bore discharge, complete segregation of the cementing slurry, piston-like back-pressure valve in the top plug, and a new cementing head for inducting any number of cementing plugs into the casing flow stream under pressure.



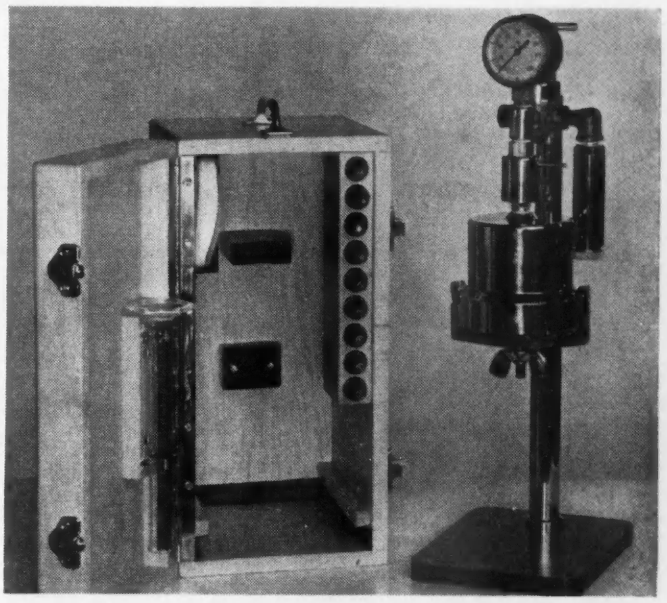
Full bore opening through the casing string is obtained by pressure-ejecting the float-in assembly from the shoe after it has fulfilled its sole function of floating the pipe into position. Use of the two-plug "Fulbore" method reduces jetting action of the cement. The back-pressure valve is a full closure, piston-like unit, made to seal and lock in a non-retractable position in the venturi tube of the stall collar.. This piston valve is conveyed to the stall collar by the top plug following the cement slurry.

The collapsible cementing plug has "up and down" sealing lips on the lower sealing portion of the plug. It has a hollow bore with molded-in ferrules at both ends. When not used to convey the back-pressure valve, the upper ferrule is blanked off. The lower ferrule receives an ordinary cork to hold the water placed in the hollow bore of the plug before it is inserted in the cement head. Thus, the plug has the attributes of a solid plug, though having the capability also to be deformed and to reform its shape.

Constricting the collapsible cementing plug through the cement head before it enters the casing flow stream ejects the cork from the plug. Fluid immediately returns to the bore of the plug after the construction is passed. As a result, in the flow pattern provided by the full bore opening in the casing string, piston-seal effect to the casing walls is assured at all times.

For additional information write Rector Well Equipment Company, Inc., Fort Worth National Bank Building, Fort Worth.

2—Filter Press



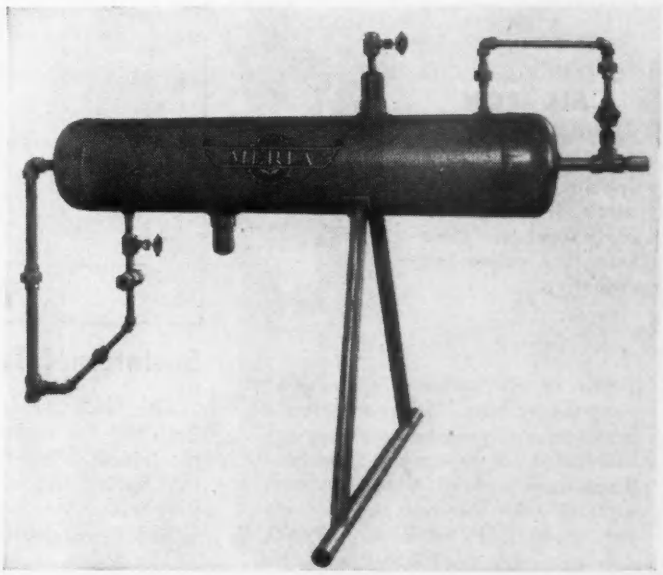
The Fann Filter Press is a compact, portable instrument for determining water loss and filter cake characteristics of drilling mud. Fluid pressure for the tests is supplied by small carbon dioxide cartridges such as those used in mixing drinks and making whipped cream. The inexpensive cartridges are obtainable almost anywhere and each has sufficient volume for three ordinary determinations.

The filter cell is of brass, the body and top being of one piece. By use of neoprene "O" rings an effective seal is accomplished with very little pressure on the sealing screw. No distortion of the sealing gaskets occurs and the filtering area remains constant.

The base is a brass casting, heavy enough to give the instrument stability, provided with a telescoping standard to support the upper section. The instrument is only 12½ inches high when in a carrying position. The case is sturdily constructed of hardwood and provided with compartments to carry all necessary accessories. Included are one graduate, one package of filter paper and ten extra pressure cartridges. Total weight of instrument, case and accessories is 17 pounds.

For additional information write Geophysical Machine Works, P. O. Box 6101, Houston.

3—Chemical Lubricant

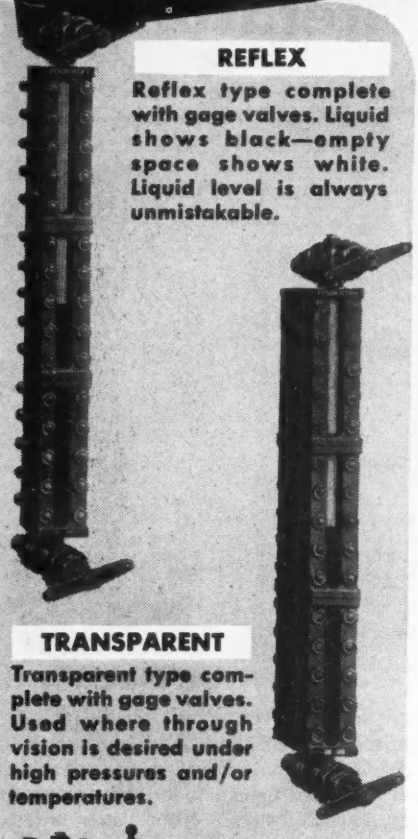


A gravity-feed, high-pressure chemical lubricator has been designed to inject chemicals into casingheads, flow lines or gas lines under high pressures. it is most commonly used for injecting tubing scale inhibitors (such as calgon solutions) or paraffin solvents into the casing annulus of wells to prevent deposits of calcium sulphate, calcium carbonate or paraffin from forming in the tubing, flow lines, traps and treating systems. It also may be used for lubricating fresh water into the casing annulus of wells to dissolve salt deposits.

The lubricator is furnished complete with needle valve for adjustment for rate of feed, high pressure bullseye sight feed, filler plug, drain plug, bypass connection and stand. Maximum recommended working pressure is 1000 pounds per square inch.

For additional information write Merla Tool Corporation, P. O. Box 2576, Dallas 1.

PENBERTHY
Liquid Level GAGES

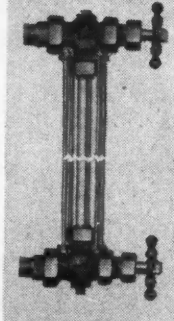


REFLEX

Reflex type complete with gage valves. Liquid shows black—empty space shows white. Liquid level is always unmistakable.

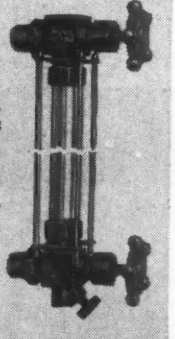
TRANSPARENT

Transparent type complete with gage valves. Used where through vision is desired under high pressures and/or temperatures.



DROP FORGED STEEL

Tubular glass type, Chrome-Moly temperature resisting steel body, stainless steel trim, regrinding removable seats.



ALL IRON

Tubular glass type, extra heavy body of special high strength alloy iron, shanks alloy steel, trim stainless steel, valves self-cleaning.

There is a Penberthy Gage of superior quality for every liquid level gage requirement. Gages are fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. All Penberthy Gages conform with API-ASME requirements.

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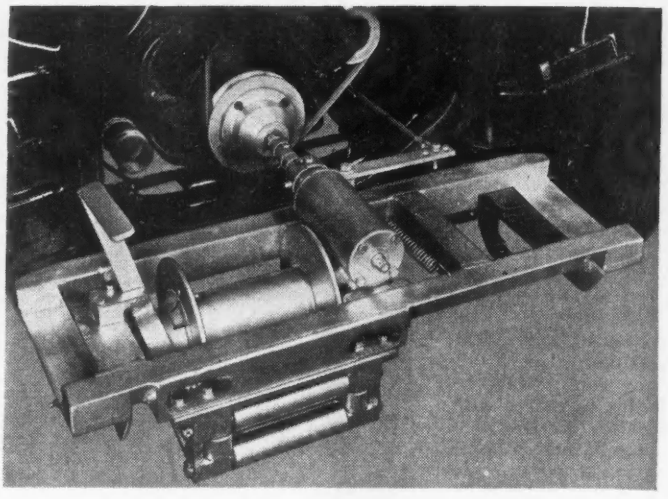
PENBERTHY PRODUCTS

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

4—Front-End Winch



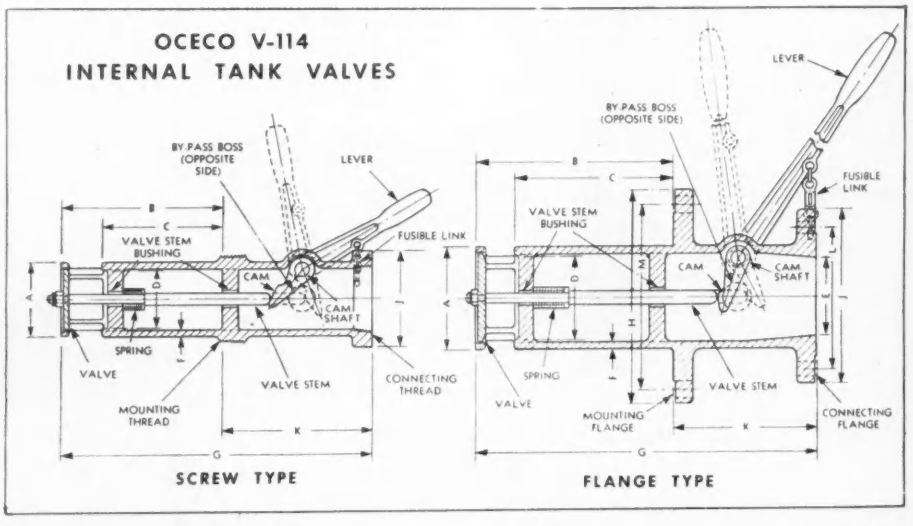
A new driving mechanism has been developed for Ramsey Model 101 aluminum front-end winch. Designed for pulling light vehicles out of the mud or over rough terrain, the winch has prevented many costly and time-consuming delays to seismograph, geophysical and other field crews.

Model 101 is now driven from the front end of the automobile crankshaft by an enclosed, self-aligning, jaw-type clutch, eliminating the need for any power take-off. Design of the clutch prevents its installation out of line or losing alignment after being installed.

The positive crankshaft clutch permits quick and easy changing of fan belts without dissembling the clutch. The clutch jaws are precision made and operate in a grease bath, making engagement or disengagement of the clutch easy when the engine is idling. Mud, water or foreign matter cannot enter the sealed clutch, which is operated from the driver's position.

These winches are furnished with special frames to fit each of the more popular light vehicles, making field installation simple and easy. All units are furnished with clutch assembly, inside cab control, and a four-way, all-steel cable guide roller. Weight of the winch is only 32 pounds, while the total weight of the completed assembly including winch line and tail chain is approximately 100 pounds. On passenger cars and pickup trucks, the winch is mounted inside the radiator grill of the vehicle.

For additional information write Ramsey Brothers Manufacturing Company, P. O. Box 3035, Tulsa 8.



5—Internal Tank Valve

The OCECO Internal Tank Valve is designed for tanks containing combustible liquids when fire regulations require that such tanks be equipped with valves that will close automatically when subjected to exposure fires.

The valve is hel dopen with a lever fastened to the body with a fusible link. At 165° F. the fusible link melts, releasing the lever, and permitting the spring to seat the valve tightly to shut off the flow. A boss on the side can be drilled and tapped for a bypass connection to permit easy operation of the lever if tank pressures exceed 15 pounds per square inch.

Type V-114 valves can be mounted on a saddle on the side of the tank. The three-inch screwed-type valve can be mounted on a tank flange. The 3-, 4-, 6-, and 8-inch flanged valves can be mounted respectively inside a 4-, 6-, 8- or 10-inch tank nozzle. They extend at least one inch inside the tank shell when mounted on a standard API single flange tank nozzle, and consequently are free flowing even when the nozzle is constructed of extra-heavy pipe.

For additional information write Johnston & Jennings Company, Oceco Division, 877 Addison Road, Cleveland.

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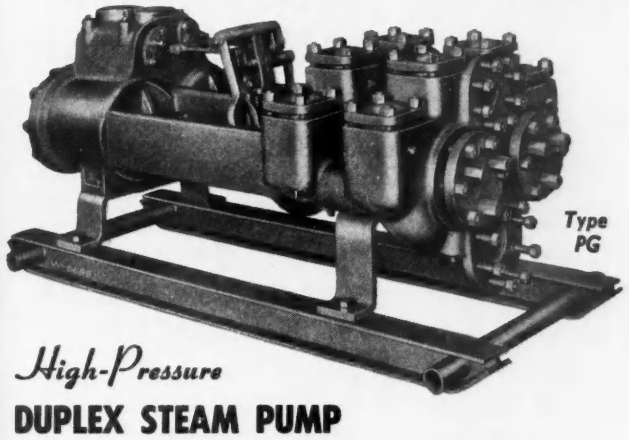

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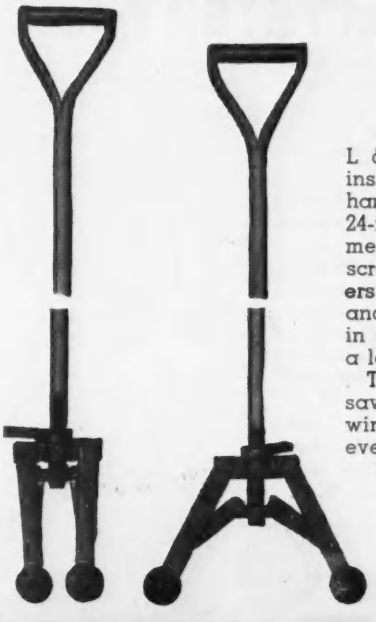
PIPE ROLLER



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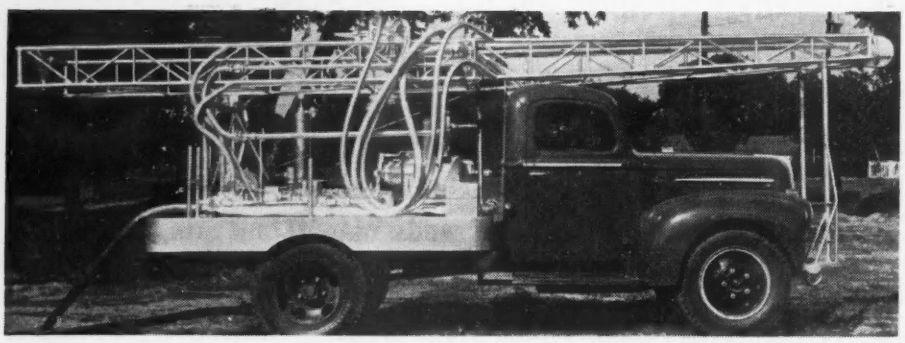


6—Shot Hole Drill

An all-hydraulic seismograph shot hole drill utilizing established physical principles of power transmission by hydraulic pressure operates with an 11-foot continuous non-chucking hydraulically controlled stroke, and drills a 10-foot joint of N-Rod drill stem with each setting. The ten-foot hydraulic cylinders are an integral part of the 22-foot mast, which is of high tensile alloy aircraft steel tubing. The mast is of the open faced type and permits the pulling of drill stem in doubles, or 20-foot sections. The floating rotary head is powered by two 15 horsepower hydraulic motors and the Braden hoisting winch also is powered with a similar motor. Two 15 horsepower hydraulic pumps which drive the unit can be operated in series or parallel as desired, with a high-pressure booster pump supplying additional fluid for extreme power requirements.

The drill is equipped with either a 4 x 5 or a 4½ x 6-inch mud pump. It is light, weighing only 11,300 pounds when mounted on a standard Ford truck.

Other advantages cited for the new drill include variation of the speed of the rotary table through a wide range from a few revolutions up to several hundred per minute without loss of power or change in the torque applied to the bit. The feature of being able to control the speed of the rotary table without loss of power or torque nor the loss of water being displaced by mud pumps is particularly advantageous.

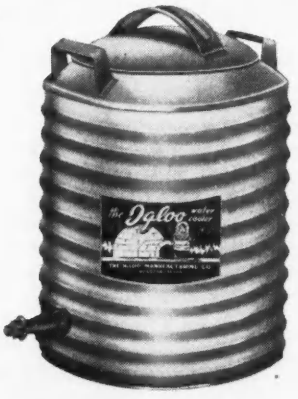
For additional information write Century Geophysical Corporation, 1333 North Utica, Tulsa.

7—Water Cooler

The Igloo Water Cooler is made with deep culvert-type corrugations which add to strength and durability of the unit. It is of all-welded construction, with no solder joints to break-out.

This cooler may be used as a top-opening can, or the spigot may be installed quickly for instant conversion to the side-spigot type. It is well insulated with granulated cork and is designed to keep water at cold temperatures for long periods.

For additional information write The Igloo Manufacturing Company, 3809 McKinney Avenue, Houston, Texas.



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Oil field engines run long—and hot! Wear is greater, life is shorter—unless you give special care. Top cylinder lubrication is your easiest way to add years of extra service to the life of any engine.

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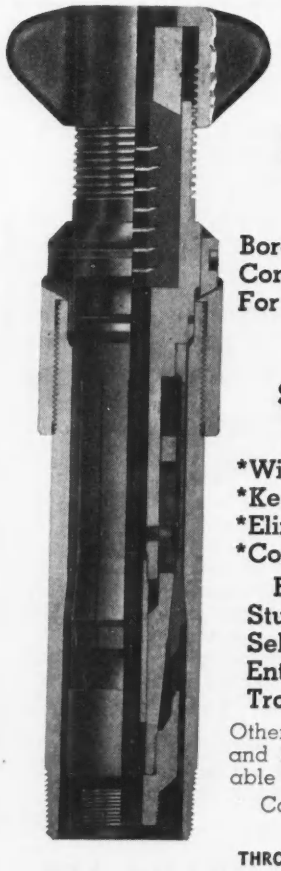
The Marvel Inverse Oiler, easily installed, proportions the flow of Marvel Mystery Oil precisely to the needs of your engine.



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LINE WIPER
No. 8000

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Connection	3"
For Line sizes	3/16 to ⅞"

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*Wipes the line clean
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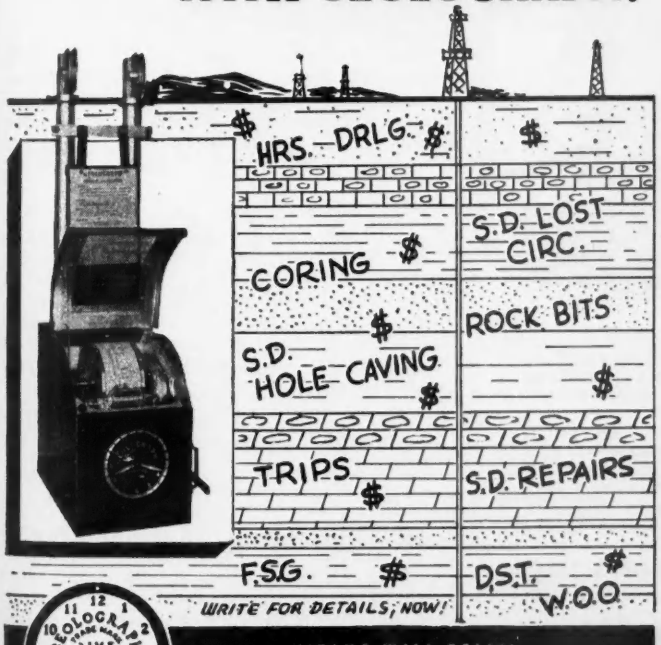

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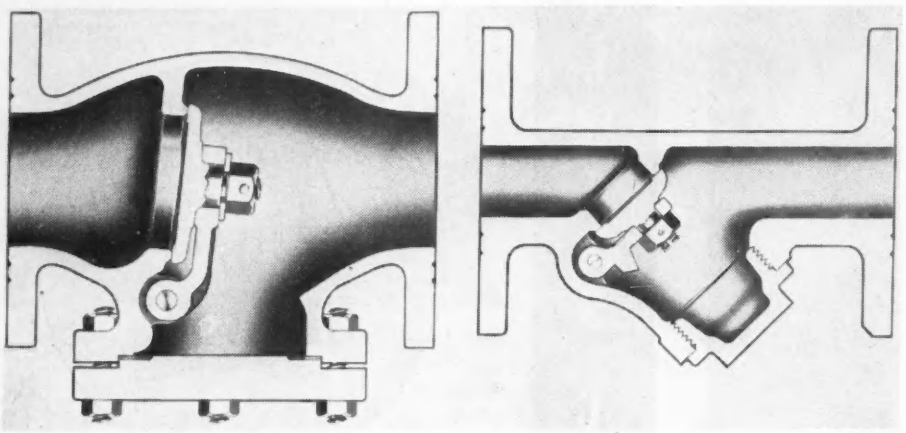


8—Swing-Check Valve

The new corrosion-resistant swing-check valves, sizes ½- to six-inches, are designed for the moderate pressures and temperatures usually encountered in piping corrosive fluids. The valves are recommended for liquid or gas pressures up to 150 pounds and for a maximum temperature of 350° F.

In the sizes ½- to two-inches, the body is made in a Y-pattern, and the cap is on the same center line as the seat opening. The large cap-opening gives access to the internal parts when the cap is removed, so that seating surfaces can be reground without taking the valve body from the line. A slot in the end of the disc spud permits rotating the disc with a screwdriver.

In the 2½-, 3-, 4- and 6-inch sizes, the body is the straightway type, with the seat face at only a slight angle from vertical. This design permits full straightway flow, with a minimum of flow resistance and pressure drop. In these sizes the cap is bolted to the body. The seat in these valves is cast as part of the body, and the face is accurately machined to assure pressure-tight seating of the disc.

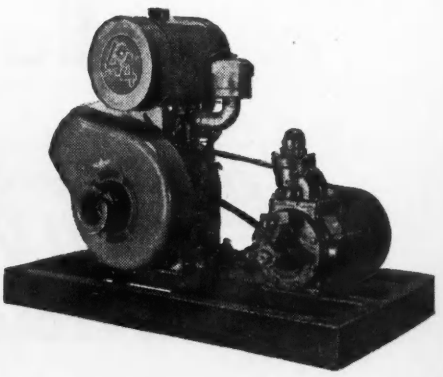
When so ordered, the 2½- to six-inch valves can be furnished with outside lever and weight, which can be applied either to assist the disc in closing, making the valve extremely sensitive to reversal of flow, or to balance the disc, causing the valve to open under a minimum of pressure.

For additional information write Crane Company, 836 South Michigan Avenue, Chicago 5.

9—Tank Bottom Circulator

A new rotary pump unit, Model BE-20 Southwest Tank Bottom Circulating Unit, has been designed for efficient circulating and treating of tank bottoms. The unit comprises a bucket-type rotary pump with self-adjusting buckets to compensate for wear, mounted on a welded steel base 20 inches wide and 34 inches long. It is driven by a 4.4 horsepower, four-cycle, air-cooled engine. The pump rotates at 575 revolutions per minute, and each of the four buckets on the rotor shovels a slug of oil from the intake, across the pump to the discharge at low velocity and with little turbulence or slippage.

The standard unit has a capacity of 27 barrels per hour at 90 pounds maximum pressure. All wearing parts are



said to quickly replaced in the field without need of special tools or skilled help, and without disturbing pipe connections. Special pump units of the same type are available up to 750 gallons per minute with gasoline engine or electric motor drive.

The unit is claimed to reduce the length of time required to treat tank bottoms, reduce the amount of treating chemical required and the amount of heat necessary to treat the oil. It is designed to pass the pumpage through the pump with a minimum of turbulence and velocity, and so prevent the forming of tighter basic sediment.

For additional information write Southwest Equipment Company, 919 South Ervay Street, Dallas.

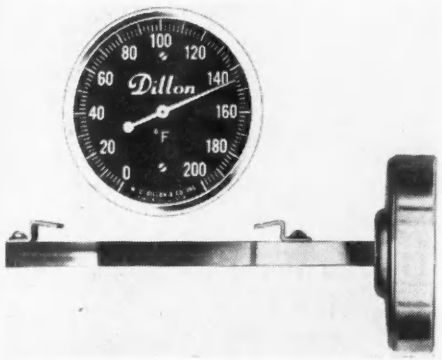
10—Indicating Thermometer

The Dillon flat stem, dial-type thermometer has been designed to clamp primarily on flat or rectangular surfaces, such as power bus-bars, switch blades, engine blocks, water jackets, etc. With the flat stem design, the heat element goes down snugly against the object under test and presents a wide heat ab-

New HEAVY-DUTY ELECTRIC PLANT
5000 WATTS
Only 272 lbs!
5CK-115M
$545.00
FOB MINNEAPOLIS
• Large capacity, compact design, and lightweight aluminum construction are combined in this new, rugged, portable electric plant. Easily carried by two men. Powered by Onan 10 HP horizontally-opposed, two-cylinder, 4-cycle, air-cooled engine. Unusual operating economy. Shipped complete, equipped with four-receptacle outlet box and mounted in tubular-steel guard frame.
NEW ONAN CK ELECTRIC PLANTS are available in 5,000 Watts D.C., 115 and 230 volts; 2000 and 3000 Watts A.C. in all standard voltages.
ONAN ELECTRIC PLANTS—A.C.: 350 to 35,000 Watts in all standard voltages and frequencies. D.C.: 600 to 15,000 Watts, 115 and 230 Volts. Battery Chargers: 500 to 6,000 Watts, 6, 12, 32 and 115 Volts.
ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5.5 HP. IB: 1-cylinder, 3.25 HP.
Onan PRODUCTS
Write for Catalog
D. W. ONAN & SONS INC.
4753 Royalston Ave., Minneapolis 5, Minn.
ONAN ELECTRIC PLANTS

sorbing area. Ordinary "C" clamps will hold the thermometer in place, or it can be drilled and tapped and screwed down in any position.

This thermometer can be supplied in

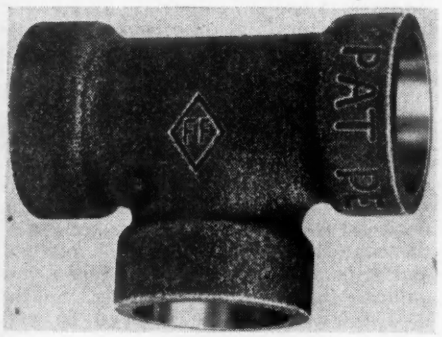


flat stems of varying widths, thicknesses, and lengths. The stems are available in a wide range of metals, and the following capacities are standard: 0-200° F., 50-500° F., 150-750° F., and 200-1000° F. Three-inch and five-inch dials are also standard, and Centigrade ranges are available on order.

For additional information write W. C. Dillon & Company, Inc., 5410 West Harrison Street, Chicago 44.

11—Malleable Fittings

Flagg-Flow malleable pipe fittings, the first threadless malleable fittings made for brazed pipe joints, have been introduced to simplify any piping layout, and to make it possible to join steel or



wrought iron pipe without threads and without welding.

These fittings produce a joint which is said to be a "one piece" system as strong as the pipe itself while affording a 30 percent reduction in weight. The cup of this fittings is reamed to accommodate the outside diameter of standard pipe and also to produce a shoulder or stop for the pipe when it is inserted. The smooth inside wall materially reduces the pressure loss of liquid systems, particularly when handling viscous or semi-viscous fluids.

Silver brazing alloys are recommended for Flagg-Flow joints for industrial installations where temperatures up to 450° F. and pressures up to 300 pounds per square inch are anticipated. Threadless malleable fittings are applicable wherever 150-pound, standard weight, black, malleable, screwed fittings are now used.

For additional information write Stanley G. Flagg & Company, Philadelphia.

Smart Prof!

The brain-trusters who advised the New Deal on financial matters gave most of us a sorry opinion of pedagogues.

Fred Rogers Fairchild, Professor Emeritus of Political Economy at Yale, has some of the gumption needed to get us back in the groove. He says that more and more money will lead to more and more government, until the tail wags the dog. In other words we are headed for totalitarianism unless we cut out government borrowing and whittle thick slices annually from the national debt.

To normal American people, accustomed to worry about private debt, it seems a wee bit ridiculous that Congress should discuss the relative merits of reducing or increasing the national debt.

Yet they have, and will. The national debt will be kicked around like a football in a bowl, and some folks will cheer at any touchdown behind any goal line. Getting around to professors again, Harold M. Groves of Wisconsin, Political Economist, says we shouldn't worry about the national debt unless it gets to be more than twice the national income!

In the meantime, how about your income tax? Do you want it to buy more government and pay more bureaucrats, or would you like for Uncle Sam to pay some of his bills and go in for old-fashioned economy?

Well, you'll have to get sore audibly before the boys in Washington stop consulting theorists like Professor Groves!

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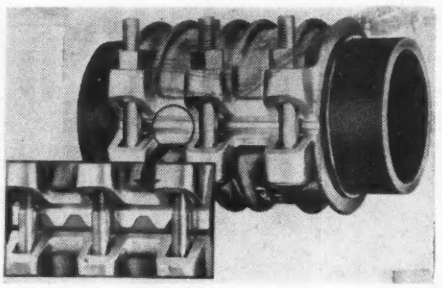
12—Pipe Repair Clamp



Broken or split cast iron or cement-asbestos pipe can be repaired in about six minutes by one man with a new cast bronze full-circle repair clamp. Bronze coupling and duronze nuts and bolts extends the life of the unit against corrosion.

A unique feature is the manner in which the clamp forms a complete, water-tight circle that compensates expansion and contraction of the pipe. A special molded rubber gasket is bonded to a copper sleeve which fits inside the coupling body. When the two halves of the coupling are closed around the pipe, the fingers slide smoothly along the copper armor until they overlap to form a full wrap-around. Thus, the rubber gasket cannot wrinkle or gather under the coupling. The result is a complete, strong encirclement with pressure so well equalized that even weak-walled pipes are not crushed.

For additional information write Smith-Blair Company, South San Francisco.

Bottom Water is a drain on profits

Eagle Lead Wool

shuts out Bottom Water!

To insure an uninterrupted flow of oil from your wells, banish bottom water with economical Eagle Lead Wool. This finely stranded metallic wool, tamped around the hole, effectively seals every crack, becomes a permanent, non-corrosive plug. Packed in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle Wire Containers sized to fit all casings.

These 3 Eagle Bearing Metals meet most requirements

Eagle Dreadnaught — for extreme speed and heavy-duty conditions.

Eagle Outlasta — for medium speed and average-load conditions.

Eagle Durable—for low speed and light-duty conditions.

EAGLE LEAD WOOL

Seals off Bottom Water—keeps 'em flowing!

THE EAGLE-PICHER COMPANY

EAGLE Since EP 1843 PICHER

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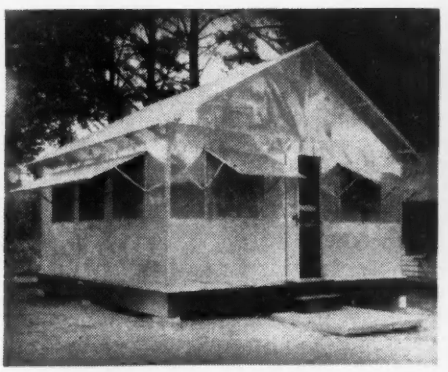
13—Aluminum Buildings

Portable, prefabricated aluminum buildings are making operations in remote areas more efficient and comfortable. Because of their light weight, they may be hauled to inaccessible areas or



shipped to other countries to provide living quarters and office space for pipe line crews, geophysical parties, or field development personnel.

Made of light gauge aluminum sheeting, aluminum channels and angles, the standard building is 16 by 16 feet and has all aluminum bolts, nuts and rivets. Aluminum screens and awnings are furnished as well as felt base linoleum floor covering. Total shipping weight of the standard building is 3375 pounds, and it comes packed in four sides, two gables, and six roof sections. Special roof sections can be shipped to permit two standard buildings to be erected together, making one double room building measuring 16 by 32 feet. Additional partitions can be furnished upon request.

Two men are required for erecting the aluminum structure, which is said to be ideal for any climate and especially for tropical and arid areas. They are fire proof and rust proof. They can be erected on a concrete base or blocks as desired.

For additional information write Williams Brothers Corporation, Chamblee, Georgia.

14—Coupling

The Saftyweld Coupling is a device for joining pipe line sections quickly and securely so that flow can be resumed immediately and welding performed with the line in flow and under pressure. Out-of-service time is thus reduced.

It is said to eliminate hazards in the

The Igloo WATER COOLER

"the truly Convertible Cooler"

This cooler is corrugated for greater strength and durability being of all welded construction. It is fully insulated with granulated cork to keep water colder longer. Added features include, conversion from spigot to non-spigot type, no solder joints to break out and a reinforced innerbottom.

Igloo Water Coolers and Spigots Are Available at All Supply Stores

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Built especially for oil field use. Anchors for your portable drilling mast, well servicing mast, pulling truck, floor blocks and derrick guy wires, or wherever dead men are needed.

For Detail Information Call or Write H. R. OSBURN

GRIP-TITE MANUFACTURING CO.

P. O. Box 46 Phone 3372

Marshall, Texas

Grip-Tite Equipment available thru your Supply Store

1st NATIONAL

STATEMENT OF CONDITION

At the close of business December 31, 1947

RESOURCES

Cash on Hand and Due from Banks	$113,578,977.29
United States Securities Owned	65,240,045.15
Other Stocks and Bonds	7,314,255.43
Loans and Discounts	133,933,716.19
Banking House and Equipment	2,371,844.38
Other Assets	1.00
	$322,438,839.44

LIABILITIES

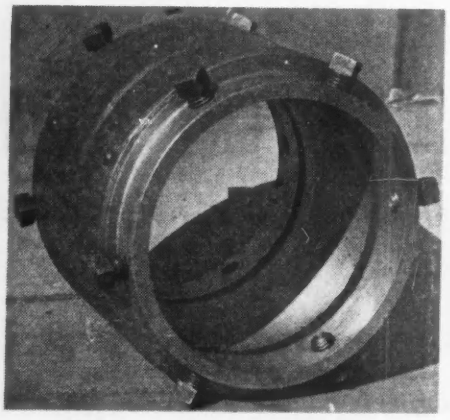
Capital Stock	$ 7,500,000.00	
Surplus Fund	7,500,000.00	
Undivided Profits, Net	5,652,568.66	$ 20,652,568.66
Reserved for Taxes, Etc.		2,115,194.60
DEPOSITS:		
U. S. Gov't	$ 6,002,867.28	
Other Deposits	293,668,208.90	299,671,076.18
		$322,438,839.44

First National Bank in Dallas

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

use of mud, asphalt, or rubber plugs during cutting and welding. It avoids all possibility of blowouts or explosions in the line or in the surroundings.

Available in sizes for two-inch pipe



up to 30-inch, the coupling consists of a steel sleeve with internal grooves into which are fitted Neoprene packing rings. It has ⅛-inch pressure connections and clamping set screws.

In use, the coupling is slipped onto the pipe after it has been cut into by a hacksaw or wheel cutters, and the new section of pipe set in place. The screw clamps are tightened and a putty-like lubricant is forced behind the Neoprene packing rings to seat them against pipe walls. As soon as the lubricant appears at adjacent holes or as soon as the packing starts to bulge up, the lubricating gun is disconnected and the plugs are inserted. The coupling is then safely welded because all flow of gas is shut off. The set screws are removed and sealed.

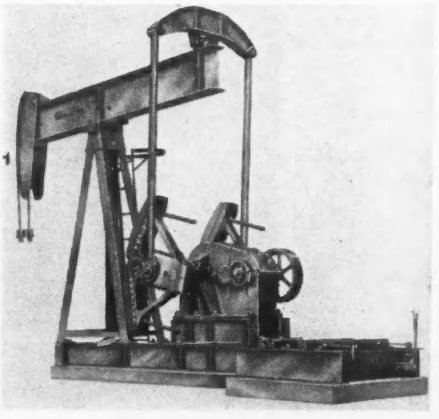
For additional information write Clark Goodman Supply Company, 1265 West Second Street, Cleveland 13.

15—Pumping Unit

Fifteen improvements in design have been included in the API model twin-crank pumping unit, the frames and sampson post of which are electric welded. The frames are rigidly braced and have extensions that can be easily adapted through the use of bolts to accommodate various types of prime movers, including engines which have no sub-base.

The walking beam is carried on widely spaced saddles equipped with needle bearings. The beam can easily be adjusted toward or away from well center by means of set screws. Hangers are easily removed for well servicing without disturbing other parts of the unit. An equalizer is equipped with needle bearings lubricated through a tube from an easily accessible point near the top of the safety ladder. This equalizer permits rotation in two planes, giving positive self-alignment between the two pitmans which are designed so that the connecting bolts do not carry the pitman load.

Safety features of the unit include a band-type brake with remote control lever and sampson post ladder with



safety loop at the top. The speed reducer is designed according to API specifications.

For additional information write the American Manufacturing Company of Texas, Fort Worth 1.

16—Hy-Lift Ram

The story of Hy-Lift Rams, a new feature of the Ideco Rambler Rig, is briefly told in Bulletin HL-47. Field installation views and detail drawings show the function and advantages of this hydraulic lift principle in elevating the protable drilling rig.

International Derrick & Equipment Company, Dallas.

17—Oil Field Engines

Applications and features of the GM Series "71" diesels are presented in a 16-page bulletin, "Oil Field Engines." Descriptive information points out the features of the popular "Quad" and "Twin" engine units. Actual field installation photographs are included with line drawings and technical data covering this series. Brief specifications and performance curves also are presented.

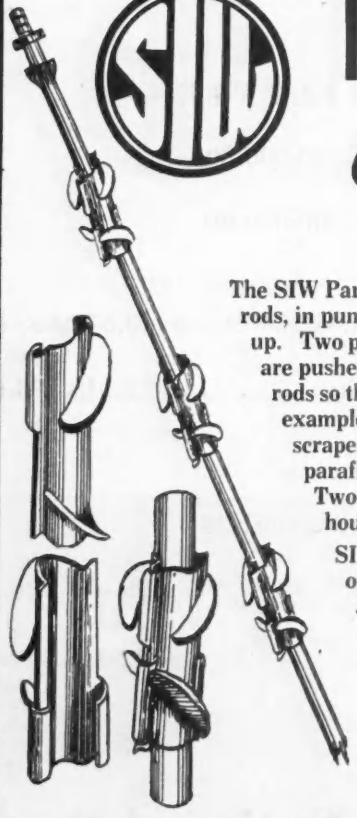
Diesel Engine Sales, General Motors Corporation, Philtower Building, Tulsa.

18—Weatherproofing

"Lasting Protection for Metal Surfaces" is a 12-page, illustrated bulletin describing a recent development for protecting outdoor structures against weathering. The booklet tells how the "Dum Dum for Metal" provides a tough but elastic and pliable wather-resistant, water-repellent coating for use on both new or uncoated metal structures and over previously cooled surfaces that "seals out" measurable moisture, vapor, and chemical gases and fumes. Seven typical applications are given, along with directions for using the material and preliminary surface preparation required.

The Arco Company, 7301 Bessemer Avenue, Cleveland 4, or 745 East 59th Street, Los Angeles.

SIW
PARAFFIN
Control Tools



The SIW Paraffin Scraper type M-16 is for use on sucker rods, in pumping wells, to keep the well from paraffining up. Two pieces, each tapered, tighten on the rod as they are pushed together. These scrapers are placed on the rods so that they pass each other on the stroke. As an example, for a well on a thirty-eight inch stroke, eight scrapers would be placed on each rod down to the paraffin level, which is usually one thousand feet. Two men can easily put on seventy-five pair per hour.

SIW Paraffin Scrapers keep the well walls free of paraffin. Price is 55c per pair on all sizes. Jack for application is only $15.00. Write for Literature.

Sunshine Iron Works

S-I-W PARAFFIN SCRAPER
TYPE M-16

601 W. MURPHY ODESSA, TEXAS PHONE 4374

NEW EQUIPMENT
LITERATURE

19—Merla Catalog

Ten individual bulletins combined with parts and price lists make up the Merla Tool Catalog, revised as of January 1, 1948. Drawings, photographs, specifications and descriptions are presented for the Type W surface controlled intermitting valve, Type A differential flow valves, Type AP surface controllers, hook-wall packers, Merla-Parks pressure regulator, Type 300 back-pressure regulator, chemical lubricators, orifice well testers, standing valves, hanger nipples and filter drips. The catalog is loose-leaf bound with heavy paper covers.

Merla Tool Corporation, P. O. Box 2576, Dallas.

20—Electric Welding Equipment

A 12-page Twecolog describes the complete line of TWECO welding electrode holders, ground clamps, cable connectors, machine terminals, cable splicers, lugs and carbon holders. Quantity price and parts informations are included. The bulletin also shows new models.

Tweco Products Company, Wichita 1, Kansas.

21—Franks Catalog

A new catalog of oil field equipment contains field photographs of each Franks Manufacturing Corporation product. The catalog offers a complete presentation of the extensive line of Franks drilling rigs and servicing units. It presents the oil field equipment in three different sections: (1) well servicing units, (2) drilling units, and (3) miscellaneous products.

Franks Manufacturing Corporation, Whittier Station, Box 3218, Tulsa.

22—Turbines

A fully illustrated, eight-page booklet on the solid rotor type steam turbine includes all the information necessary to management and power plant engineers. Profusely illustrated, the Whiton Steam Turbine booklet shows in detail the many engineering feature of the turbine. In addition there are engineering drawings and dimensional data that should be useful in selecting the size and type of turbine needed for specific applications.

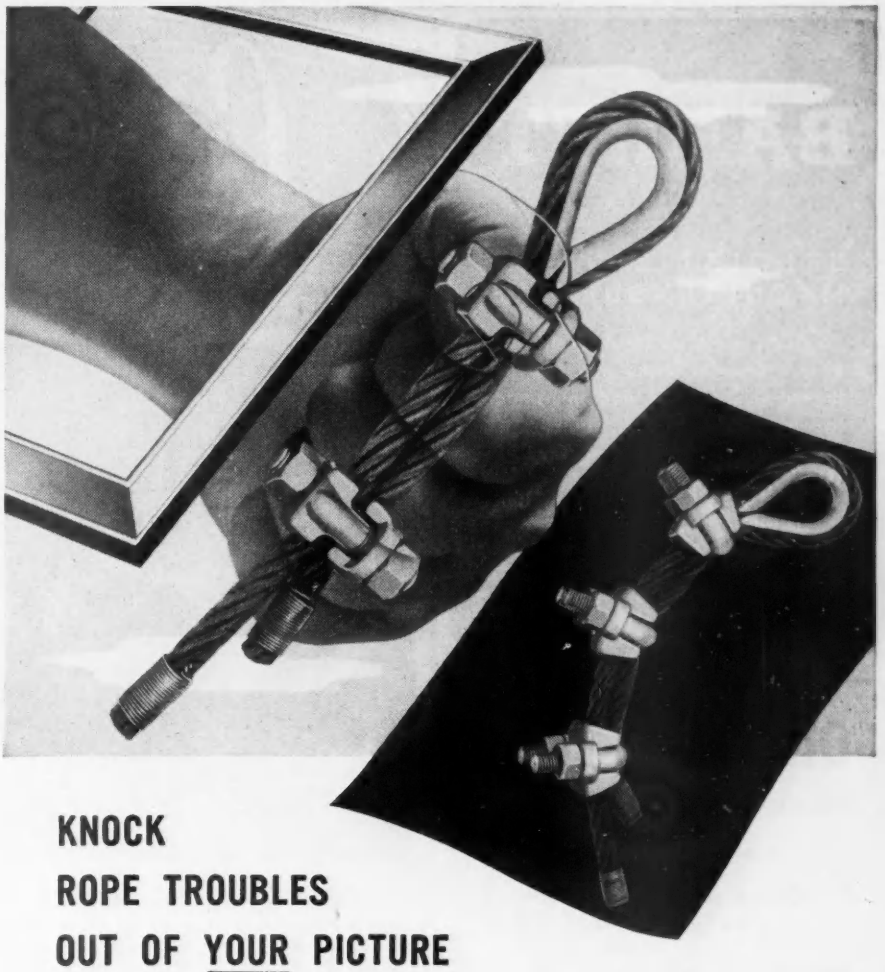
The Whiton Machine Company, New London, Conn.

23—Valves

An Edward catalog sections describes forged steel chrome-molybdenum Intex and Univalves.

Univalves are welded bonnet integral seat valves for service at 1500 and 2500 pounds at 1000° F. Intex valves are bolted bonnet integral seat valves rated at 1500 pounds, 1000° F. The bulletin gives details of construction, dimensional and design data, material specifications and other data.

Edward Valves, Inc., East Chicago, Ind.



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"Fist-Grip" Clips develop 95% to 100% of the rope strength. They can make important savings in time, money and rope . . . for *you*. Distributed through mine, mill and oil field supply houses. WRITE FOR LAUGHLIN'S CATALOG #140 . . . up-to-the-minute data on industrial fittings.

THE THOMAS LAUGHLIN CO., DEPT. 23, PORTLAND 6, MAINE.

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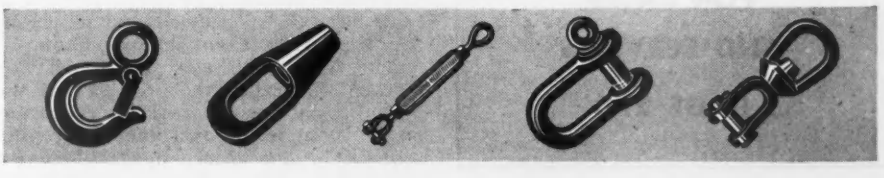
THE MOST COMPLETE LINE OF DROP-FORGED WIRE ROPE AND CHAIN FITTINGS



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Mimeographed copies of the 1946 lecture series are available at $7.50 per copy. Also available at $3.00 per copy "A Short Summary of the Law of Oil and Gas" by D. H. Gregg, Legal Department of the Humble Oil & Refining Company.

SOUTH TEXAS COLLEGE OF LAW

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HOUSTON, TEXAS

1948 Petroleum Directory Available

Barkley's Directory, the WHO'S WHERE among Producers, just off press! Lists all producers and associated personnel in Gulf, Mid-Cont. and Rky. Mt. Areas—over 30,000 listings covering 18 states. The company landman's handbook since 1934. Send $15 for your copy under our MONEY BACK guarantee, or write for Sample Sheet W. Barkley Directory, 324 Esperson Bldg., Houston.

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The Trading Post

FOR SALES AND SERVICES

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Associations

MID-CONTINENT OIL & GAS OFFICIALS—A. R. Carmody (second from left) has begun his third term as president of the Mid-Continent Oil & Gas Association, Louisiana-Arkansas division. W. H. Rector, Little Rock (left); R. L. Keyes, New Orleans (second from right); and C. H. Murphy, Jr., El Dorado, Ark., (right) were elected vice presidents. Vice presidents reelected were John J. Frommer, Joe T. Goodman, C. H. Lyons, A. H. Tarver and A. H. Weyland, all of Shreveport. Sam S. Caldwell, Shreveport, was relected executive vice president and secretary-treasurer.

Raymond A. Stehr Elected Dallas Geological President

Raymond A. Stehr of Seaboard Oil Company is the new president of the Dallas Geological Society.

Other officers are John T. Rouse, Magnolia Petroleum Company, vice president; H. V. Tygrett, The Atlantic Refining Company, secretary-treasurer; and Barney Fisher, Comanche Corporation, executive committee member.

Willard G. Wiegel Heads AGA Southwest Personnel Group

Willard G. Wiegel, personnel director, Lone Star Gas Company, Dallas, has been elected chairman of the Southwest Personnel Conference of the American Gas Association. E. A. Werner, manager, Personnel department, Gulf States Utilities Company, Baton Rouge, was elected vice chairman, and R. P. Marshall, personnel director, Memphis Natural Gas Company, Memphis, Tenn., was elected secretary.

Nominations for the 1948 slate of officers were submitted by a committee consisting of M. V. Cousins, director of personnel, United Gas Pipe Line Company, Shreveport, and H. D. Carmouche, general superintendent, Houston Pipe Line Company, Houston.

The AGA Southwest Personnel Conference was established during the war period to discuss personnel operations under complex governmental regulations. The conference meets about four times a year to review and discuss developments in the field of employee relations. Executives in charge of industrial relations of all gas companies in the area are welcome at these meetings.

Promotion Coordinator Named For American Gas Association

H. Vinton Potter has been appointed co-ordinator of promotion of The American Gas Association. He will coordinate all the promotional activities of the association on an industry-wide basis under the new organizational procedure instituted with the adoption of the promotion, advertising and research plan by the executive board of AGA.

Colonel John H. White, Jr., who joined the Association as director of sales promotion in 1945, has resigned. The organizational work and the preparation of promotional material in which he specializes, have been completed and he expects to announce shortly his plans for carrying on such activities in another field.

Oil Scouts Elect

Jack H. Sigmon, Gulf Oil Corporation, Amarillo, Texas, has been elected president of the Panhandle Oil Scouts Association. Other officers include: B. L. Anderson, Skelly Oil Company, Pampa, Texas, first vice president; Fred S. Alexander, Stanolind Oil & Gas Company, Amarillo, second vice president; Fred D. Mason, The Superior Oil Company, Amarillo, secretary-treasurer.

Chairmen Announced for API Spring District Meetings

Chairmen of committees in charge of activities and arrangements at the spring meetings of the American Petroleum Institute's Division of Production districts have been announced.

Following are the meeting dates, sites and chairmen for the districts.

Eastern District: June 30 to July 2, Greenbrier Hotel, White Sulphur Springs, W. Va. District chairman, J. V. Goodman, Equitable Gas Company, Pittsburgh; program-committee chairman, E. T. Heck, Quaker State Oil Refining Corporation, Bradford; general arrangements-committee chairman, E. H. Tollefson, Hope Natural Gas Company, Clarksburg, W. V.; publicity-committee chairman, Paul J. Kesel, Carnegie Natural Gas Company, Pittsburgh; and registration-committee chairman, Hugh Brankstone, Gulf Oil Corporation, Pittsburgh.

Pacific Coast District: May 6-7, Biltmore Hotel, Los Angeles. District chairman, E. V. Watts, General Petroleum Corporation, Los Angeles; general chairman of meeting, Lot Bowen, Western Gulf Oil Company, Los Angeles; program-committee chairman for drilling session, O. W. Chonette, The Texas Company, Long Beach. Production-session chairman, M. B. Standing, California Research Corporation, La Habra. General arrangements committee chairman, I. B. Doyle, Hydril Tool Company, Los Angeles.

Southwestern District: April 14-16, Plaza Hotel, San Antonio. District chairman, B. J. Dowd, Union Producing Company, Shreveport; general arrangements chairman, Al Buchanan, Al Buchanan Drilling Company; program chairman, R. E. Bridges, Humble Oil & Refining Company, Houston; registration chairman, R. S. Christie, Amerada Petroleum Corporation, Fort Worth; meeting room arrangements chairman, John B. Stephens, The National Supply Company; publicity, B. D. Stevenson, San Antonio *Express*; entertainment, Frank B. Lefevre.

Mid-Continent District: March 24-26, Broadview Hotel, Wichita, Kansas. District chairman, W. L. Horner, Barnsdall Oil Company, Tulsa; program, Lloyd E. Elkins, Stanolind Oil & Gas Company, Tulsa; general arrangements, H. E. Zoller, Derby Oil Company; publicity, A. S. Ritchie, Wichita; hotel facilities, Lloyd R. Pickrell, T. C. Johnson estate, Wichita; entertainment, Henry E. Miller, The Globe Oil and Refining Company; co-chairman, Leo L. Ross, Lario-Globe Oil Company; registration, Jack Abernathy, Big Chief Drilling Company, Oklahoma City.

Rocky Mountain District: Chairman, H. A. Stewart, The Texas Company, Denver. Plans not completed.

Shawnee Scouts Elect

Henry Edwards, scout for Tide Water Associated Oil Company, has been elected president of the Shawnee Scout Check. Other officers include Allen Richards, The Pure Oil Company, vice president, and Dick Riggs, Stanolind Oil & Gas Company, secretary-treasurer.

Don't Let the "GRAY MARKET" ROB the Midwest and Southwest

[The shortage of nails and a prevalent "gray market" in this product are receiving much publicity.]

This is SHEFFIELD'S Answer to that Situation—

In addition to the unprecedented demand for nails today, there are other factors affecting the shortage in the Midwest and Southwest. Some mill-owned warehouses in this territory have been discontinued and some faraway producers have been obliged, for economic reasons, to suspend business on nails in this area. ***This places a heavier burden on our customers and us alike.***

Today, Sheffield Steel Corporation is making more nails than ever before in the history of its business — in a sincere effort to supply the heavy demand.

We are following the time-proven method of distribution through established channels. Our nails are being sold ***only*** to legitimate, reputable distributors and dealers—at our ***regular market prices.****

There undoubtedly is a "gray market" on nails throughout the United States, but it is less prevalent in the Midwest and Southwest than elsewhere. To prevent the territory which we serve from contributing to this serious situation, we ask all of our customers ***not*** to sell nails at other than ***regular established prices.*** We implore users of nails in this area ***not*** to pay anyone more than ***legitimate established prices.*** Let's all do our part, by distributing nails wisely in our own territory. ***Don't let the "gray market" rob the Midwest and Southwest.***

***This policy applies to all Sheffield products, listed below.**

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HOUSTON — Carbon and Alloy Steel, Ingots, Blooms, Billets, Plates, Sheets, Merchant Bars, Steel Joists, Structural Shapes, Road Guard, Reinforcing Bars

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OIL COMMITTEE CHAIRMAN RECEIVES AWARD—Fred F. Murray, president, Oil Well Supply Company, Dallas, chairman of the oil industry's public relations committee in the Gulf-Southwest, receives top award from Gerald Cullinan, president of the Texas Institute of Public Relations, for industry public relations achievement in Texas in 1947. Left to right, Cullinan; Paul Cain, Fred Eldean Organization, oil industry public relations counsel; and Murray.

Industry Public Relations Committee Wins Top Honors

The Gulf-Southwest District of the Oil Industry Public Relations Committee received top recognition for industry public relations activity during 1947 in the annual awards of the Public Relations Institute of Texas, results of which were announced at the Institute's annual awards meeting at Dallas. Fred F. Murray, chairman of the industry's committee in the Gulf-Southwest, comprising Texas, New Mexico, Louisiana, Arkansas, Mississippi and Alabama, received a citation for outstanding achievement from Gerald Cullinan, president of the Texas public relations association. Murray is president of Oil Well Supply Company.

"Efforts of members of all segments of the oil industry toward creating better relations with the public have paved the way toward a higher appreciation of all industry's value to Texas and Texas people," said Cullinan, in awarding the citation to Murray's committee. "This program to make more friends for the oil business has resulted in more friends for all Texas industry. In the short space of time that the oil industry's program has been in operation, it has made a greater impression on public consciousness than any comparable program ever launched."

Co-recipients with Murray of the award were John P. Morgan, Sun Oil Company, committee vice chairman, and Paul Cain, Fred Eldean Organization, the industry's public relations counsel.

Suman Addresses Students

John R. Suman, vice president of Standard Oil Company (N. J.), spoke on the "Advisability and Opportunities for the College Engineering Graduate Going into Foreign Work" before the Petroleum Engineering Club of Texas A. and M. College December 17.

Ralph B. Lloyd Named Head Of Western Oil, Gas Group

Ralph B. Lloyd was named president of the Western Oil and Gas Association for 1948.

William Reinhardt was chosen first vice president; William F. Humphrey, second vice president; L. K. Whittier, treasurer; Don E. Gilman, executive vice president; David S. Kilgour, secretary; George F. Prussing, technical secretary; and John M. Peirce, economist.

Directors named were C. R. Allen, Leigh M. Battson, S. Belither, James B. Black, Harold L. Briggs, H. D. Collier, J. A. Crawford, S. J. Dickey, E. S. Dulin, Rodney S. Durkee, Leroy M. Edwards, R. P. Huggins, Wm. F. Humphrey, C. A. Johnson, C. S. Jones, W. M. Keck, Ralph B. Lloyd, A. C. Mattei, S. B. Mosher, William Reinhardt, L. P. St. Clair, J. B. Sutherland, Reese H. Taylor, C. P. Watson, Torrey H. Webb, A. L. Weil, W. C. Whaley, and L. K. Whittier.

Purchasing Agents Elect

F. P. Nopper, Gulf Oil Corporation, was elected president of the Purchasing Agents Association of Tulsa, Okla. Other officers include C. W. Wallace, Mid-Continent Petroleum Corporation, first vice president; J. C. Nicholson, The Trebolite Company, second vice president; V. M. Lewis, Dowell Incorporated, secretary-treasurer; H. M. Cosgrove, executive secretary; E. R. Welch, assistant secretary; and G. C. Heidinger, Stanolind Oil & Gas Company, national director.

ASSOCIATIONS

Authors of Volume on Oil and Gas Conservation Are Chosen

Walace Hawkins, chairman of the publications committee, Section of Mineral Law, American Bar Association, announced the names of those selected to participate in the writing of a volume on oil and gas conservation law.

Publication of the book is set for September, 1948. Editorial supervision is under the direction of Blakely M. Murphy, professor of law, at the University of Tennessee, Knoxville.

Members of the publications committee are Robert E. Hardwicke, Fort Worth; Earl Foster, Oklahoma City; Northcutt Ely, Washington, D. C.; who have outlined, with Prof. Murphy, the scope of the volume and assigned the topics to writers.

Sections are devoted to the fundamentals of reservoir behavior, the Interstate compact to conserve oil and gas, the Compact Commission; the federal government's conservation experience; and the largest division of the book demonstrates the development of the conservation pattern within 34 states.

Law School's 13th Lecture Series to Begin February 12

The South Texas College of Law's 13th series of oil and gas lectures, in which instruction is given along practical, non-technical lines, will begin February 12, it was announced by Judge E. E. Townes, dean of the school.

Some of Houston's most prominent lawyers and geologists will give the lectures at the night school operated by the Y.M.C.A. They will discuss such phases of the industry as leases, royalties, operating agreements, governmental regulations and operating rights.

This course is given primarily for the laymen and women, but also would prove beneficial for lawyers.

W. H. Randolph, educational director of the "Y" night schools, said classes would be held from 7:30 to 10 p. m. each Thursday.

Noble C. Ginther Reelected To IPAA Vice Presidency

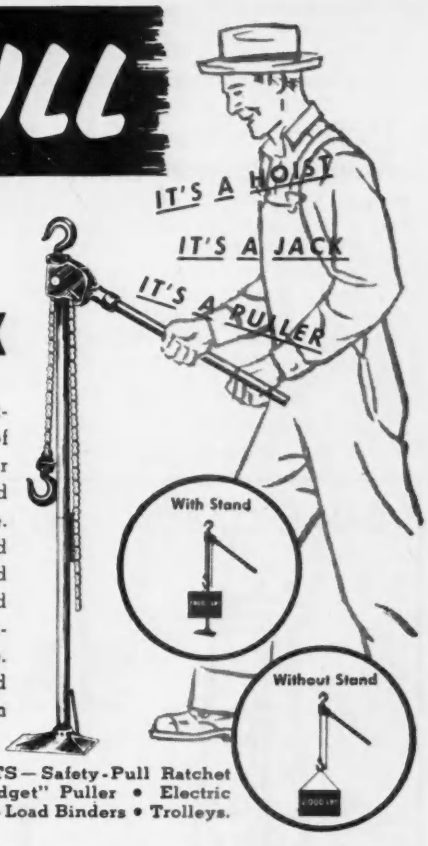
Noble C. Ginther, Ginther-Warren & Ginther, Houston, was reelected vice president of the Independent Petroleum Association of America for the southeastern area of Texas, it has been announced by Merle Becker, recently elected president of the Association at the 18th Annual Meeting in Oklahoma City. H. J. Porter, independent of Houston, was reelected a member of the executive committee of the Association.

Newly elected to the directorate is Donald Frankell, also of Houston. Tenure of office on these posts is for a period of one year.

Directors Named

James E. Allison, Warren Petroleum Corporation, and A. L. Salliday, Stanolind Oil & Gas Company, both of Tulsa, have been named directors of the General Mid-Continent Oil and Gas Association.

LIFT or PULL



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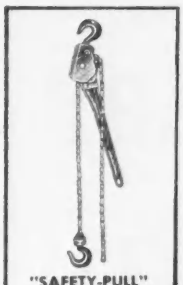

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F. M. Perry to Head NGAA Convention Program Group

Frank M. Perry, Cities Service Oil Company, Bartlesville, Okla., is to head the convention program committee for the 27th annual convention of the Natural Gasoline Association of America, according to NGAA President C. R. Williams, The Chicago Corporation, Corpus Christi. The Convention is scheduled for March 24-26 at the Texas Hotel, Fort Worth.

Other members of the committee appointed by Williams are Henry M. Brown, Midland Gasoline Company, Houston; J. H. Dunn, The Shamrock Oil & Gas Corporation, Amarillo; T. R. Goebel, Shell Oil Company, Inc., Houston; J. A. LaFortune, Warren Petroleum Corporation, Tulsa; John F. Lynch, LaGloria Corporation, Corpus Christi; Albert H. Weil, United Gas Pipe Line Company, Shreveport.

Controllers Add Members

Fladger F. Tannery, assistant controller of Humble Oil & Refining Company, Houston; Sidney J. Stacey, controller of California Texas Oil Company, Ltd., New York; James L. Polk, secretary-treasurer of Atlas Oil & Refining Corporation, Shreveport; and Eugene A. Wurster, assistant controller of Socony-Vacuum Oil Company, Inc., New York, have been elected to membership in the Controllers Institute of America.

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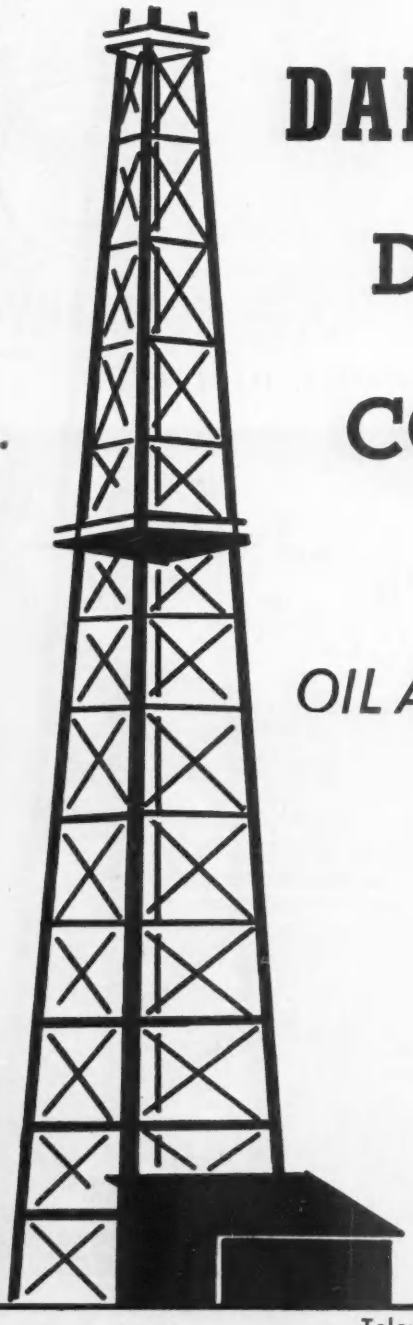

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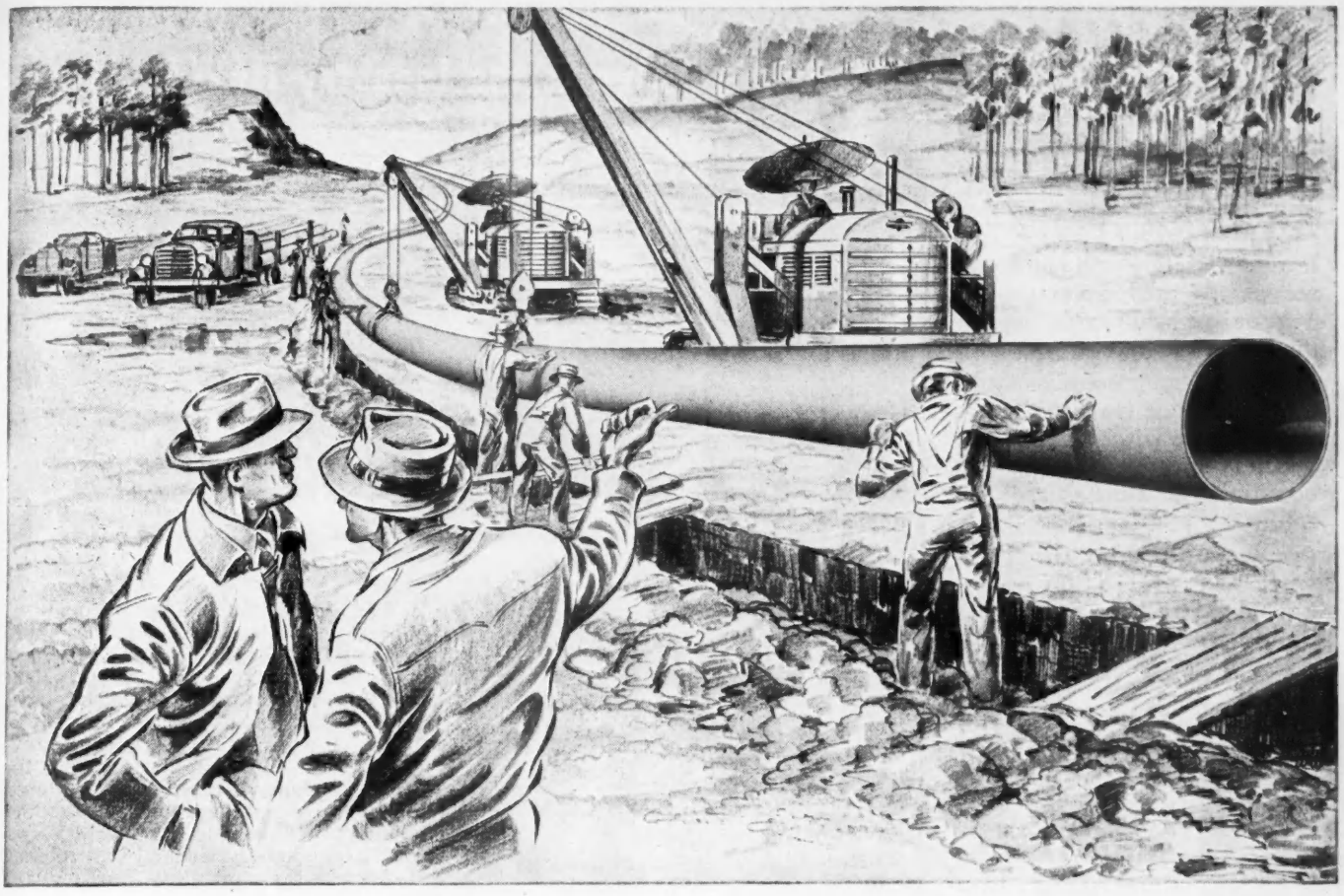
THE OIL MAN'S CALENDAR

FEB. 15–19	American Institute of Mining and Metallurgical Engineers, Annual Meeting, New York, Pennsylvania Hotel.
16–17	Kansas Oil Men's Association, Annual Meeting, Wichita.
MAR. 9–10	Wisconsin Petroleum Association, Milwaukee, Schroeder Hotel.
12–14	Texas Independent Producers and Royalty Owners' Association, Annual Meeting, Corpus Christi.
24–26	Natural Gasoline Association of America, Annual Meeting, Ft. Worth, Texas Hotel.
24–26	Southern Gas Association, Galveston, Texas.
24–26	American Petroleum Institute, Mid-Continent District, Wichita Kansas, Broadview Hotel.
APRIL 6–7	Michigan Petroleum Association, Annual Spring Convention, Detroit, Detroit Leland Hotel.
8–10	Mid-West Gas Association, Annual Meeting.
14–16	American Petroleum Institute, Southwestern District Meeting. San Antonio, Plaza Hotel.
21–23	National Petroleum Association, Cleveland, Hotel Cleveland.
25–27	Independent Petroleum Association of America, Mid-Year Meeting, Wichita, Kansas, Broadview Hotel.
26–29	American Association of Petroleum Geologists, Society of Economic Paleontologists & Mineralogists, Society of Exploration Geophysicists, Annual Meeting, Denver, Shirley-Savoy Hotel.
28–30	Liquefied Petroleum Gas Association, Annual Convention and Trade Show, Kansas City, Mo.
MAY 4– 5	American Gas Association, Natural Gas Department, Annual Spring Meeting, Houston, Rice Hotel.
6– 7	American Petroleum Institute, Pacific Coast District Meeting, Los Angeles, Biltmore Hotel.
15–22	International Petroleum Exposition, Tulsa.
27–28	Natural Gas & Petroleum Association of Canada, Niagara Falls, Ont., General Brock Hotel.
JUNE 30 July 2	American Petroleum Institute, Eastern District Meeting, White Sulphur Springs, W. Va., Greenbrier Hotel.
JUNE 30 July 3	Canadian Gas Association, Annual Convention, Jasper, Alberta, Jasper Park Lodge.
SEPT. 15–17	National Petroleum Association, Atlantic City, N. J., Hotel Traymore.
OCT. 4– 9	American Gas Association, Atlantic City.
NOV. 8–11	American Petroleum Institute, Annual Meeting, Chicago, Stevens Hotel.

Nomads Chapter monthly meetings: **Los Angeles,** second Wednesday, Jonathan Club, B. M. Landis, Secretary. **Houston,** second Monday, Houston Club, Harry E. Estes, Secretary, Telephone Charter 4-7611. **Dallas,** L. A. Little, Secretary, Telephone Justin 8-1726. **Tulsa,** third Wednesday, Hotel Tulsa, Anthony Gibbon, Secretary, Telephone 3-1844. **New York,** first Monday, Louis Sherry's, Norris Boulden, Secretary, Telephone WIckersham 2-1311, extension 260.



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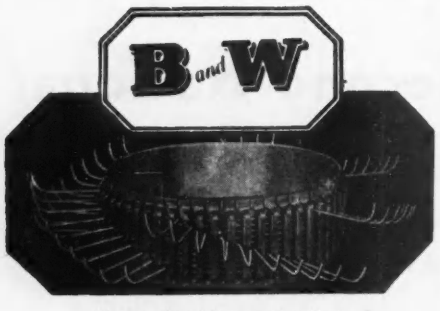

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Men in the Industry NEWS

A. E. Chester

R. D. Hanley

R. L. Minckler

S. J. Dickey

E. D. Smith

E. D. Smith has retired as director, vice president and manager of production after 29 years with Magnolia Petroleum company and has been succeeded by **A. E. Chester. R. D. Hanley** was elected a member of the board of directors. **M. V. C. Bradley** will succeed Chester as assistant manager of production. **E. L. Downing** succeeds Bradley as general superintendent of production. Smith entered the oil industry as a roustabout with South Penn Oil Company at the age of 16 and joined Magnolia in 1918 as production foreman at Augusta, Kansas. In successive steps he was promoted to district superintendent, division superintendent and general superintendent. He was elected to the board of directors and named vice president and manager of production in 1944. Chester joined Magnolia in 1919 in the old Desdemona district as one of the roustabout gang. After service in several oil fields he was promoted to foreman in 1926 and to district superintendent in 1935. He was transferred to the general office at Dallas in 1944 to serve as assistant manager of production. Hanley joined Magnolia Gas Company in 1925 and moved to Magnolia Petroleum Company in 1930 as chief chemist of the natural gas department. He was made general superintendent of that department in 1938, and in 1942 was named manager of the natural gas department. Bradley has been an employe of the company more than 26 years and has been general superintendent of production since 1946.

»

J. L. Burke, vice president of Stanolind Pipe Line Company, has been named executive vice president. **J. L. Shoemaker,** comptroller, has been named financial vice president. **W. O. Middaugh,** executive assistant to the president, has been appointed secretary; and **Wilkes Keith,** head of the tax and statistical section, has been named treasurer.

R. L. Minckler was elected president of General Petroleum Corporation succeeding **S. J. Dickey,** who retired January 1. **R. A. Sperry,** senior vice president and a director, also retired on that date. Minkler was elected a vice president in 1945 upon his return from wartime service as director of petroleum supply for PAW. In June, 1947, he was advanced to executive vice president. Minckler served in the Army during World War I and later joined General Petroleum. He became assistant to the president ten years later and in 1941 was elected a director. Dickey has been president of General Petroleum since 1941. He first joined the company in 1919, became chief engineer in 1920, a director in 1927. and vice president in charge of manufacturing in 1930. Sperry is one of the pioneers of General Petroleum and the oil industry, having started work in the Kern River fields in 1901. He joined General Petroleum in 1912, became a director in 1925, and a vice president in 1926.

»

Clarence S. Beesemyer and **Philip S. Magruder** have been named executive vice presidents of General Petroleum Corporation. Both have been vice presidents and directors of the firm, with Bessemyer serving as director of marketing and Magruder as manager of the manufacturing department.

»

John C. Sample, former general sales manager for General Petroleum Corporation, and **Arthur J. Donnelly,** industrial relations manager, were elected vice presidents. **Gale L. Adams,** manager of the manufacturing department, was named a vice president and director; and **Carroll M. Wagner,** manager of the Geological department, was chosen a director. Sample went to General Petroleum from Standard-Vacuum Oil Company in 1938 after 17 years' service in Japan and Korea. He became assistant manager of the Marketing department in 1941 and general sales manager in 1943. Donnelly joined the firm in 1924 and was named manager of industrial relations in 1944. Adams joined the Laboratories department in 1925 and advanced through various positions to assistant manager of manufacturing. Wagner joined the firm in 1919 as a field geologist and became manager in 1932.

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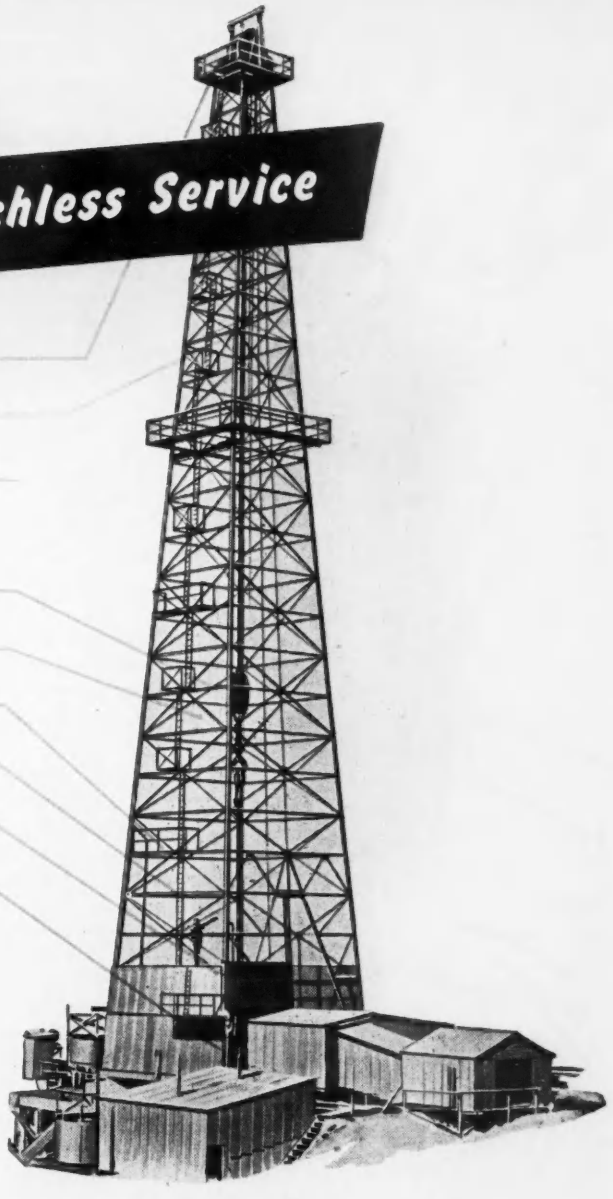

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The policy of Dresser Industries is not to compromise engineering for a sale. This carries through from well to refinery. Dresser-owned companies build equipment according to a variety of principles all along the line. You buy the type you need for best results—not some solo piece for which a salesman is holding the torch.

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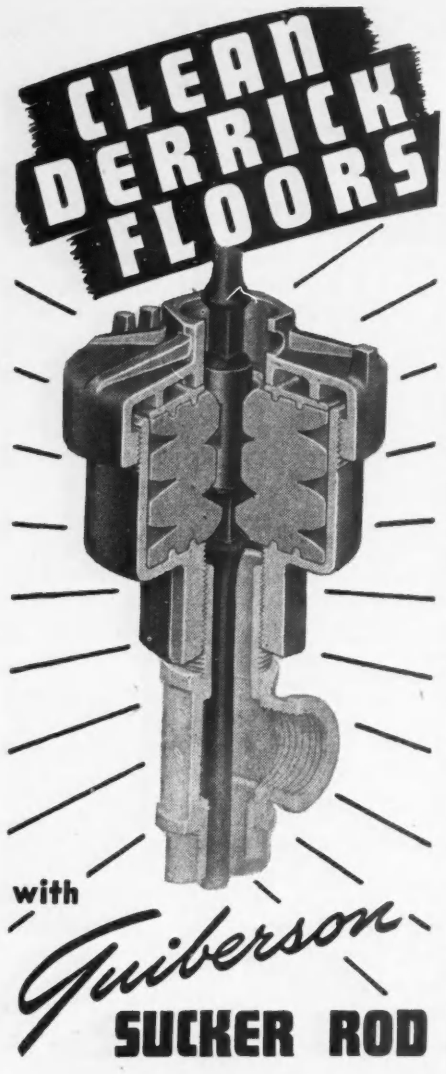
Whittier, Calif.

STACEY BROS. Gas Construction Company
Cincinnati, Ohio

Stacey-Dresser Engineering Division
Cleveland, Ohio



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MEN IN THE INDUSTRY NEWS

T. A. Atkinson, for the past three years assistant superintendent of the Southern division of General Petroleum Corporation's Production department, has been named assistant manager of the Industrial Relations department. Atkinson, the son of an oil man, began his career with the company by working summers from 1926 to 1931. He joined the company in 1935 as a well puller and has occupied various positions in the Production department.

T. A. Atkinson

»

Eugene F. McCabe, general sales manager of the Eastern division sales department of Tide Water Associated Oil Company, has been appointed a vice president.

»

J. P. Moroney, formerly in charge of the Crude Oil Purchasing department of Sinclair Prairie Oil Company at Tulsa, has been named vice president in charge of Sinclair Wyoming Oil Company with headquarters at Denver. He is succeeded by **Alexander Johnston,** who has been transferred from the Products Pipeline department of Sinclair Refining Company with the title of vice president of Sinclair Prairie Oil Company.

»

Charles B. Dale of New York City has joined the production research department of the Pennsylvania Grade Crude Oil Association as a chemical engineer in the association's laboratory at Bradford, Penn. Dale has been a chemical engineer on the staff of Foster Wheeler Corporation of New York City.

»

Frederick S. Lott, assistant chief of the Petroleum Economics Division of the Bureau of Mines for the past five years, has been named chief of the division. Lott succeeds **Alfred G. White,** chief of the division since 1936, who has been relieved of administrative duties he has performed for ten years. White will devote full time to forecasts of petroleum demands. Lott joined the Bureau of Mines in 1936 as an economic analyst specializing in natural gas. He was at the bureau's Bartlesville, Okla., station until late 1942, when he went into the Navy as a lieutenant commander. The Bureau of Mines requested his release from the Navy in early 1944 to become assistant chief of the Petroleum Economics Division.

Frederick S. Lott

R. W. (Bob) Wire of Dallas has become president and general manager of Loffland Brothers Company, Tulsa drilling contractors. Wire formerly was sales manager of the Southwestern area for National Tube Company, which includes the Tulsa, Dallas, Houston, Denver and New Orleans districts. A native of Lorian, Ohio, and a graduate of Miami University of Ohio, he was with National Tube for more than 25 years, first as field engineer, then as sales manager for the Chicago area, assistant general sales manager, and in 1945 he moved to the Mid-Continent territory in the position he just resigned. He will make his headquarters at Tulsa.

R. W. (Bob) Wire

»

Ben P. Piepgrass, formerly with Sinclair Prairie Oil Company, Tulsa, has been named head of the San Antonio land department for Midstates Oil Corporation.

»

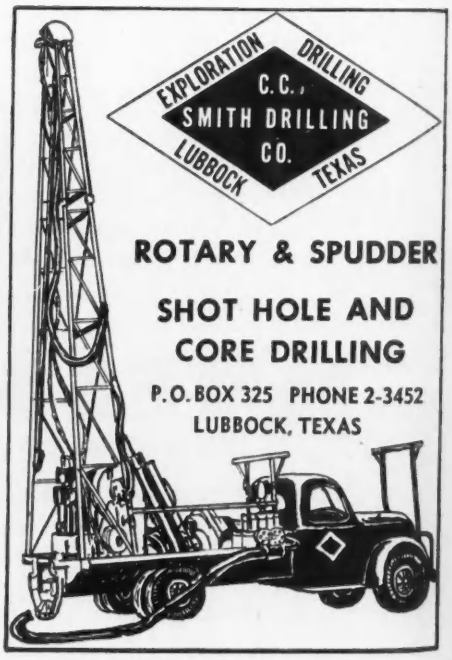
J. L. Anderson, civil engineer with Sun Oil Company at Evansville, Ind., has resigned to join **R. G. Nussmyer** in a new engineering firm at Evansville.

»

E. D. Bates has resigned as production superintendent for Ashland Oil and Refining Company, to become a consultant in oil field inventories with headquarters at Tulsa.

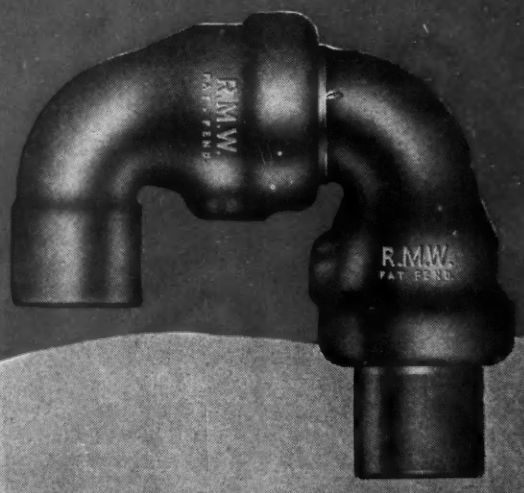
»

James Kisling, formerly with Amerada Petroleum Corporation, Tulsa, has joined the geological department of Sinclair Oil Corporation and has been assigned to Ethiopia with headquarters at Addis Ababa.



Announcing

ROOFE SWIVEL JOINTS ARE NOW MANUFACTURED AND DISTRIBUTED BY HUNT TOOL COMPANY



In order to meet increasing oil industry demands, Hunt Tool Company will greatly expand production and distribution of Roofe Swivel Joints, All-Steel Hose for drilling and cementing, Mud Guns and Mud Rotators. Domestic sales will be handled by Hunt Tool Company with foreign sales handled by Hunt Export Company.

Roofe Swivel Joints . . . in service for more than two years . . . feature a patented packing and bearing design that makes it easy to assemble or disassemble on the derrick floor, a full size streamline bore through the joint, a specially designed packing chamber that permits lubrication under pressure, and a bearing area that assures perfect alignment of all working parts.

Specify Roofe Swivel Joints. Now, there will be enough to meet your demands for every oil country use.

HUNT TOOL COMPANY

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HUNT TOOL COMPANY

A BUSINESS BUILT ON *Good* SERVICE

Earl L. McNeill has been named drilling superintendent of the Coast Company at Houston. McNeill was previously with Skelly Oil Company and the Allied Well Service, Inc. of Houston and went to Coast Company from Crown Central Petroleum Company, where he was drilling and production superintendent.

»

L. G. Smith, vice president in charge of refining activities, was elected a member of the board of directors of Creole Petroleum Corporation. The company announced the resignations from the board of **W. J. Haley** and **W. R. Goodwin.**

Miss Suzanne Takken, formerly of Cleveland, Ohio, has joined the geological staff of Magnolia Petroleum Company at Oklahoma City.

»

J. J. Oliphant has been named production superintendent of General Petroleum Corporation's San Joaquin division, with headquarters at Taft, Calif. **C. C. Gandaubert** was named assistant superintendent for the Southern division with offices at Vernon; and **A. L. Hair** was appointed drilling superintendent for the same division, with headquarters at the Wilmington offices.

With One-Piece Jars
Drilling Costs Less

Spang Weldless Drilling Jar

Spang Drilling and Fishing Jars, each made from a single piece of highest-quality alloy steel by drop and hammer forging and then heat-treated for utmost serviceability and safety, have proved their practical advantages for years, in comparison with jars of the welded type.

Spang Weldless Jars are known throughout the world, and are preferred wherever cable-tool drilling is done. While they cost more to buy, they are more economical to use because of lower footage cost and less time lost in fishing and replacement. Standard stroke lengths, diameters, and joint sizes are readily available at field stores. Special requirements can also be met, though less promptly and at some additional cost.

For the best in Cable Tools
SPECIFY SPANG

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SPANG & CO.
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YOUR DEALER SELLS SPANG TOOLS

D. L. Connelly, manager of operations in Texas and the Gulf Coast areas for Warren Oil Corporation, has been elected president of the concern, succeeding **J. H. Boyle,** resigned. Connelly will continue to maintain headquarters at Houston, all the operations of the company having been transferred to the City National Bank Building. A native of Bradford, Pa., Connelly was a second lieutenant in World War I and in 1920 joined Barnsdall Oil Company as a roustabout. Subsequently, he was with Gypsy Oil Company as scout and landman, an independent operator in West Texas, and a landman and later manager of the land and geophysical division for Indian Territory Illuminating Oil Company. When the company merged with Cities Service Oil Company in 1941, he moved to Houston as manager of the Texas land and geological division. He resigned in 1944 to become Texas and Gulf Coast manager for Warren.

D. L. Connelly

»

Thomas M. Milburn, head of the land department for George F. Getty, Inc., and Pacific Western Oil Corporation, has resigned to join **Loren Hillman,** independent operator.

»

Donald S. Kennedy has been promoted to executive vice president of the Oklahoma Natural Gas and Electric Company. **Walter B. Gesell** and **W. R. Wolfe** have been elected vice presidents.

»

Ralph L. Clarke, A. F. Keating and **E. J. Houston,** all of Tulsa, have organized the Clarke Oil Well Servicing Company, capitalized at $100,000 with headquarters at Tulsa.

»

Frank G. Evans, formerly in the geological department of Shell Oil Company, is now associated with **Carleton D. Speed,** Houston, consulting geologist.

»

John F. Partridge, Jr., has been named district geologist for The California Company at Casper, Wyo., succeeding **Gordon Frye,** resigned.

»

E. D. Truesdell, manager of the telegraph department of The Pure Oil Company, Tulsa, retired January 1, after 32 years continuous service with the company. Truesdell joined the old Pure Oil Pipe Lines Company as a night oil dispatcher at Pittsburgh in 1916 and was transferred to Tulsa two years later.

»

S. C. Oliphant has been named district superintendent of the Texas-Gulf Coast division for Stanolind Oil & Gas Company.

With SHAFFER CELLAR CONTROL GATES

not only can you vary the type of power, but also the power drive!

Here's one cellar control gate that has virtually no power limitations whatever. Not only can you operate a Shaffer Cellar Control Gate interchangeably with *any* type of power found in today's field operations—air, hydraulic, steam or electric—but you also have a wide choice of hook-up arrangements to meet the individual requirements of each rig. And with all installations you have the added safety of full manual standby. Shaffer Gates stand alone in wide-range adaptability to every field condition!

Choice of Air—Hydraulic—Steam or Electric Drives . . . plus Remote or Unitized Hook-Ups—all with full manual standby!

FOR EXAMPLE, Take the Shaffer air drives

If you want the power drive located *away* from the Gate then this Shaffer Dual Air Motor Drive is the hook-up you want. By means of an air-operated clutch its *single* Shaffer Air Motor will close and open *both* ram assemblies in a Shaffer Double Gate (or *two* Shaffer Single Gates), and it can be located either on the mat or completely outside the rig, from where it operates the rams by means of positive torque-tube drives.

Only two small air valves, mounted convenient to the driller, are needed to control all Gate operations. One valve, connected to the Air Motor by means of two simple pipe lines, operates the Air Motor in either an opening or closing direction.

The other valve, connected to the air clutch by two flexible tubing lines, selects the Gate to be operated . . . and by pre-locating this valve on the Gate desired, only *one* valve need be operated when pressure emergencies occur, reducing control operations to a minimum.

And remember—like all Shaffer Power Drives—this one has the added protection of *full* manual operation (both closing and opening) should power failures occur. The power drive is *automatically* disconnected when not in use, thus eliminating motor drag when operating the Gates manually.

If you prefer to have the power drive close to the Gate here's the Shaffer Air Motor Drive arrangement that fills the bill. On this hook-up a separate Shaffer Air Motor Drive is used for operating each ram assembly of a Double Gate (or for each single Gate), and is side-mounted directly on the Gate body and operates through a positive chain drive. A special air valve for closing and opening the Gate is installed convenient to the driller for operating each Air Motor and its air clutch. Manual closing of the Gates is accomplished in the same manner as in the Shaffer Dual Air Motor Drive described at left . . . and similarly, the Air Motors are *automatically* disconnected when not in use to eliminate drag during manual operation.

This Shaffer advantage of *complete* manual standby—both for closing and opening operations—is particularly important should power failures occur during pressure emergencies. Shaffer alone provides such vital *double* protection to safeguard your wells!

Complete Interchangeability!

Simple to install and completely adaptable, Shaffer Power Drives have the further advantage that they are quickly interchangeable. You can move a Shaffer Cellar Control Gate from well to well, and by simply changing the compact power drive, you can operate the Gate with air, hydraulic, steam or electric power—whichever is most convenient for each installation . . . always *with the added safety of manual standby!*

Before you buy *any* Cellar Control Gate equipment be sure to get the full story on Shaffer's *many* important advantages. Send for your free copy of the Shaffer Catalog which outlines other vital features.

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EXPORT SALES OFFICE: Shaffer Tool Works, 30 Rockefeller Plaza, New York, N. Y., U. S. A.

Don O. Chapell, division geologist for Sunray Oil Corporation, San Antonio, has been named a vice president and will direct a new department of exploration, with headquarters at Tulsa. **H. S. McClintock,** vice president, will continue to direct Sunray's land department. Chapell is a former district geologist for Shell Oil Company and a division geologist for Transwestern Oil Company. When Transwestern was merged with Sunray he was made manager of Sunray's Southwest Texas land and geological office at San Antonio.

Dr. Charles Allen Thomas, executive vice president and technical director of Monsanto Chemical Company, St. Louis, was selected to receive the 1948 gold medal of The American Institute of Chemists. **Dr. Foster D. Snell,** president of the Institute, stated that the award is made in recognition, not only of Dr. Thomas' work in the development of atomic energy and his leadership in research, particularly in synthetic resins, but also for his administrative ability and his encouragement of basic research.

MORE OPERATORS ARE DISCOVERING THE EFFICIENCY OF JP RODS AND LINERS

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A. Knox Tyson has resigned as manager of the Land department, Southern region, Continental Oil Company, to become vice president of Barber Asphalt Corporation with headquarters at Houston. **W. C. Stout,** division land superintendent for Continental at Fort Worth, has been named assistant manager of Continental's land department in charge of the Southern region. Tyson has been in Continental's Houston offices since 1934, and during the past six years has been manager of the Southern region land department. Tyson formerly was associated with Marland Oil Company and The Pure Oil Company and joined Continental in 1929. Stout is a 30-year veteran of the oil industry and a Continental employe since 1939, when he was a landsman at Lafayette, La. He became division landman at Fort Worth in 1941.

A. Knox Tyson

»

A. R. McTee, who was a staff writer for *The Oil Weekly* (now WORLD OIL) for eight years, will teach a new course in journalism at the spring session of the University of Texas. The course will be "Advanced Writing: Oil and Gas." An innovation for schools of journalism, the course is being offered because the increasing amount of oil news being published by Texas newspapers demands reporters with some knowledge of the industry.

»

T. M. (Ted) Cady, vice president of Texon Oil and Land Company with offices at Fort Worth, has been named division land superintendent, succeeding Stout. Cady retains his position with Texon, a Continental subsidiary, in addition to his new duties.

»

Ira H. Cram has been appointed manager of exploration for The Pure Oil Company, a newly-created post. Cram has been with the company for 23 years and has occupied various positions within the geological department, the most recent being that of assistant to **Theron Wasson,** chief geologist. He reecived his formal education at the University of Minnesota and did post-graduate work at Minnesota and Columbia University.

Ira H. Cram

»

Philip Boyle, formerly with Skelly Oil Company at Shreveport, has joined the geological staff of the Eason Oil Company at Oklahoma City.

MEN IN THE INDUSTRY NEWS

Transfers

Carl G. Herrington promoted from division manager of the Eastern division, The Carter Oil Company, Mattoon, Ill., to assistant manager of production in the Tulsa headquarters. He has been succeeded as division manager by **Kenneth A. Ackley,** who will also continue to direct exploration activities in the division which includes Illinois, Indiana, Michigan, Kentucky and Tennessee. **O. D. Harper** has been apponted production manager of the Eastern division. **Melvin E. Thrash,** scout for Continental Oil Company at Wichita Falls, Texas, promoted and transferred to Ponca City, Okla., as assistant to **W. E. Haggard** and **John W. Cram** in the Kansas-Oklahoma land and lease division. He is succeeded in North Texas by **Ben D. Donnell, Jr.,** of Wichita Falls. **George P. Zabel,** with The California Company, from Denver, Colo., to Lexington, Ky. **C. H. Danc'ertsen,** chief engineer at Seminole, Okla., for Amerada Petroleum Corporation, to Midland, Texas, and succeeded at Seminole by **J. L. Colson. Lloyd Hanson,** superintendent for Arrow Drilling Company, Tyler, Texas, to Odessa, Texas, as superintendent for West Texas and New Mexico, replacing **J. W. Hall,** who resigned to join Trinity Drilling Company. **J. B. Daw** succeeds Hanson as Arrow superintendent in the East Texas district. **Robert W. Worthing,** geologist with Stanolind Oil & Gas Company, from Tallahasee, Fla., to Oklahoma City. **T. W. Bell** from district engineer, Fellows district, Engineering division of The Texas Company, to division engineer with headquarters at Los Angeles; **W. F. Cory** from development engineer, Los Angeles Basin, to district engineer, Fellows district; **L. E. Chatfield** from production engineer, Fellows district, to district engineer, Sacramento district; **O. W. Chonette** from production engineer, Los Angeles Basin, to district engineer, Los Angeles Basin; and **F. W. Maloney** from production engineer to district engineer, Ventura district. In the Production and Drilling division, **R. L. Patton** changes from district engineer, Ventura district, to assistant superintendent, Ventura district.

⌄

F. E. Mallonee, superintendent of the Kansas division for Magnolia Petroleum Company, has retired. The Illinois division has been discontinued and operations in Illinois, Kentucky and Tennessee have become a part of the Kansas division under supervision of **John F. Conley,** division superintendent, with headquarters in the First National Bank Building, Wichita, Kansas. **Louis Enloe** retired and operations in the Salem district are under the supervision of **Wade G. Moriarty,** district superintendent. **J. M. Courtney** retired and operations in the Rodessa, La., district are under the supervision of **Walter M. Pittman,** district superintendent.

⌄

C. A. Reynolds, a resident partner of Main & Company, Houston, since 1943, has been admitted as a general partner in the accounting firm, which is a specialist in old field accounts. Reynolds has practiced public accounting for 26 years in Texas, Oklahoma and Pennsylvania.

THE 1948 YEARBOOK-FORECAST

Petroleum facts and forecasts

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- Drilling in 1947 and forecast for 1948
- Wells to go on pump in 1948
- Consumption trends and prospects
- 1947 wildcatting and 1948 prospects
- 1947 pipe line construction and outlook
- Footage drilled in 1947 and estimate for 1948
- Oil and gas production rates and forecast

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COMPANY_____

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CITY & STATE_____

Check branch of industry

☐ Drilling Contractor
☐ Producing Company
☐ Pipe Line
☐ Individual Producer
☐ Manufacturing
☐ Supply

W. H. Schluneger has resigned as district geologist for the Atlantic Refining Company and has opened offices at Tulsa, specializing in the study and interpretation of surface geology. He had been associated with Atlantic for 28 years.

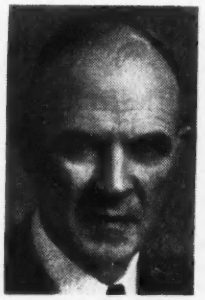
»

R. E. Nelson, Jr., has been named manager of the Texas-Louisiana Gulf Coast division of Stanolind Oil & Gas Company, with offices at Houston

Fred E. Hummel, metallurgical engineer formerly with Shell Oil Company, has become a consultant, with offices at Ojai, Calif. He is a graduate of the School of Mines and Technology, South Dakota, and has been employed by Shell since 1935.

»

J. H. Wimberly, vice president and treasurer of Houston Natural Gas Corporation, was named executive vice president, and **Grover Jones** was elected secretary-treasurer.



J. E. Rouse

A. L. Solliday

A. L. Solliday has been named executive vice president of Stanolind Oil & Gas Company and has been succeeded as operating vice president by **J. E. Rouse.** Solliday joined Dixie Oil Company as a scout in 1923, became district geologist in 1925, and was promoted to superintendent of the Land department when Stanolind was organized in 1931. He became manager of the Exploration department in 1932 and was elected a director and vice president in charge of operations in 1944. Rouse joined Standard Oil Company of New Jersey in 1913. Subsequently, he was construction engineer for Midwest Refining Company, and when that firm was purchased by Standard Oil Company (Indiana) he was promoted to assistant general superintendent of the Casper refinery and ten years later was placed in charge of all refineries in the Rocky Mountain division. He became assistant general manager of manufacturing for Standard Oil Company (Indiana) in 1933 and in 1943 was loaned to the government. He joined Stanolind in 1945 as manager of the Manufacturing department.

»

Storrs J. Case has been named advertising manager of Sun Oil Company. Case, a native of Detroit, has been in advertising or sales promotion in the automotive field for 24 years. **Fred S. Cannan** will be assistant manager in charge of motor products advertising, and **Laurens H. Fritz,** assistant manager in charge of industrial products advertising.

»

Gavin Witherspoon has been elected vice president of Bahrein Petroleum Company, Ltd., in charge of producing activities. Witherspoon entered the foreign field in 1936, first as petroleum engineer in Arabia and Bahrein and later as assistant manager in Arabia. After a period of other assignments in the U. S., he became manager of producing operations for Bahrein in 1944.

Gavin Witherspoon

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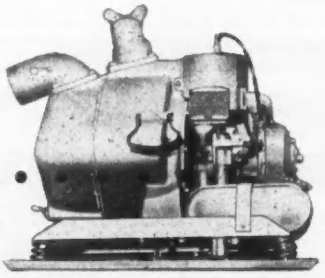
AS GENERAL PARTNER

NEW YORK PHILADELPHIA HARRISBURG

PITTSBURGH HOUSTON

stumped for a **pump?....**



HOMELITE *"Carryable"* Pumps are roughnecks. They run anywhere in any weather. They start quickly and run without fuss or attention. Mud and sand don't bother HOMELITES; they've no pockets to accumulate solids. They're lightweight and compact in size (that's why we call them *"Carryable"*). And that's how you can save time and money by getting them on the job sooner. The 3-inch model moves 15,000 G. P. H. at open discharge; lift of 28 feet is guaranteed, too. See for yourself. Ask us to send a HOMELITE Demonstration Truck to call at your location. There's no obligation, of course.

HOMELITE CORPORATION

in the Southwest:
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Oil Center's NEW, LONG STRING, CASING HEAD PACKS OFF

With

Murray Rubber

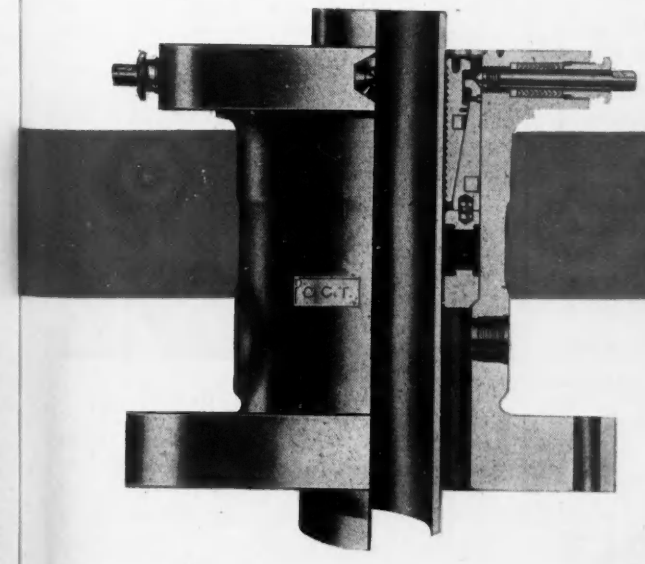
Shown above is the slip-pack hanger assembly for the new O-C-T Type "C-19" Casing Head shown in cross-section below. The well head hook-up at right, employing a "C-19" Casing Head and Spool, was installed on the world's deepest well to suspend the greatest weight and length of casing ever set.

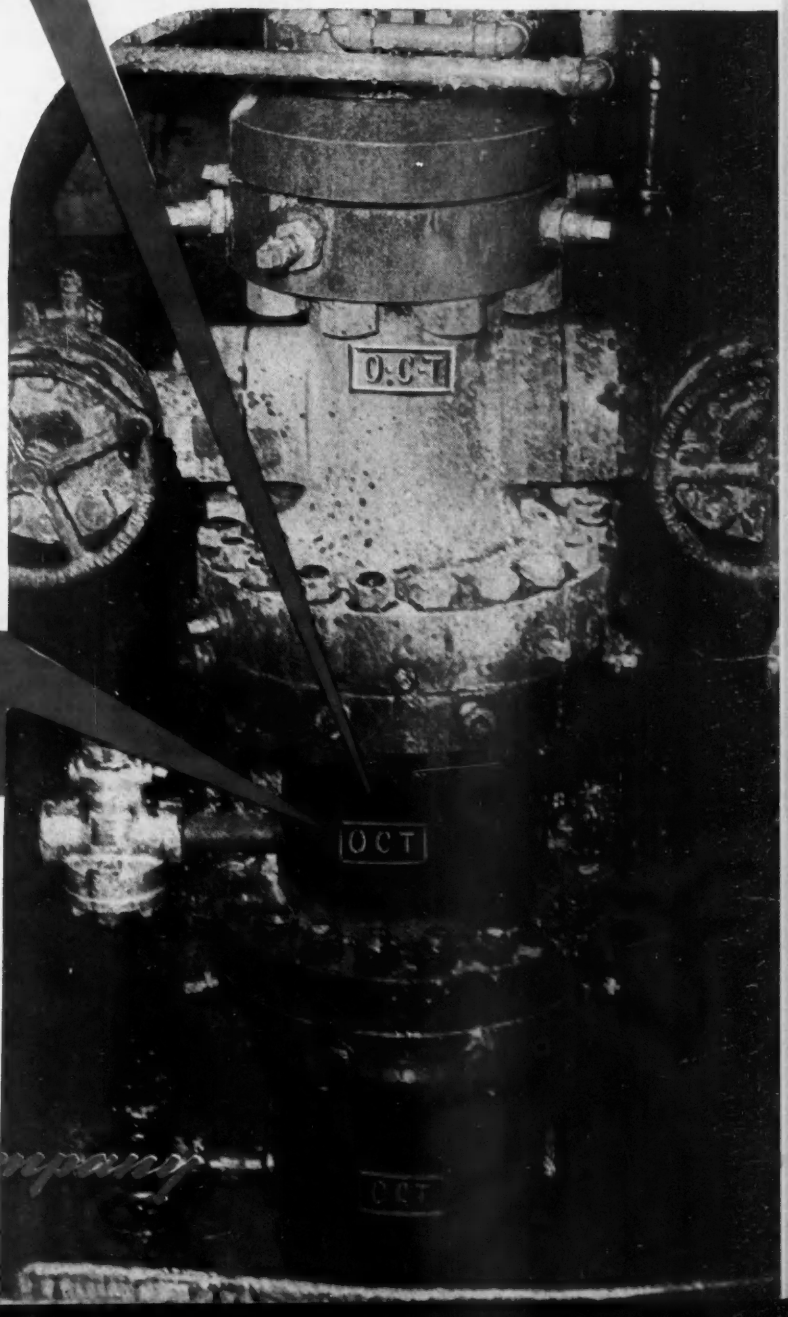
As a rule, long, heavy casing strings are set in wells in which extremely high gas pressures are frequently encountered, making it doubly important to provide a dependable casing seal.

In producing the resilient Hycar rubber seals for these new, heavy-duty O-C-T well heads, Murray Rubber Company drew on its many years of specialized experience in compounding and molding rubber parts for the oil tool industry.

That Murray has again recommended the right rubber for the job is clearly indicated by the already generous acceptance given these well heads and their satisfactory performance on a number of tough jobs.

Whatever your mechanical rubber problem may be, Murray engineers will gladly consult with you on developing the right rubber for the job . . . from blueprint to finished product.





Murray Rubber Company

HOUSTON, TEXAS

Miss Peggy Cantrell of Bristow, Okla., graduate assistant in the Geology Department at Oklahoma University, has been elected secretary of the National Chapter of Chi Upsilon, honorary geological society for women.

»

Earl A. Nichols, formerly Mid-Continent Division manager for Core Laboratories, Inc., has announced the opening of a consulting petroleum engineering office at Dallas.

James W. Foley has been appointed assistant manager of the Oklahoma division, producing department, The Texas Company. Foley, who formerly was assistant to the manager of the producing department, will have headquarters at Tulsa. A native of San Augustine, Texas, and a 1932 graduate of Texas A. and M. College, he joined The Texas Company the same year. After serving as petroleum engineer in the Conroe field, the Laredo district, and the Rocky Mountain division, he was stationed at Bahrein Island in 1937 and remained until 1940, when he became petroleum engineer at Lafayette, La. After serving as superintendent of the Erath Unit operation, he was transferred to the Louisiana division as superintendent of gas-gasoline operations in 1944.

»

William H. Garbade, Shell Oil Company, Inc., New York, was elected president of Deep Rock Oil Corporation, succeeding **Henry N Greis** who died in July. **C. K. Baxter,** who assumed the duties of president on an interim basis following Greis' death, will continue in his capacity as chairman of the board. Garbade holds a master's degree from New York University's School of Commerce, Accounts and Finance, and has had 15 years of experience in several different branches of Shell's operations including marketing, transportation and supplies, organization work and economics, in addition to financial and accounting activities. He also participated in the reorganization of Shell's distribution system in Western Europe in 1946 following the end of hostilities.

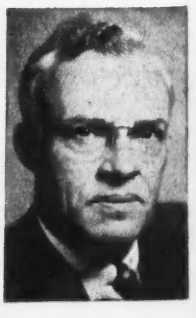
W. H. Garbade

»

Rex L. Dawson, formerly division land man for The Carter Oil Company for the Northwestern division at Denver, has been appointed division land and scouting department manager of the Western division, Imperial Oil, Ltd., with headquarters at Calgary, Alberta, Canada. Dawson had been with Carter 30 years.

»

Dr. E. F. Davis, vice president of Shell Oil Company, and the company's chief consulting geologist for the North American continent, retired January 1 after nearly 30 years' service. Dr. Davis attended the University of California where he obtained his Ph.D. in 1917. Shortly thereafter he joined Shell in New Mexico and went to California in 1922 as chief geologist, a position he held until 1929, when he was elevated to vice president and chief geologist. In 1940 he succeeded the late **J. U. Stair** as vice president in charge of the Los Angeles office. Dr. Davis continued in this capacity until late 1944, when in addition to his vice presidential duties he became chief consulting geologist for the North American continent.



Dr. E. F. Davis

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For WIRE LINE CORING

Be Sure IT'S A KING *Be Safe*

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KING 4C CIRCULATING HEAD AND 4AR WIRE LINE STRIPPER

The King 4C Circulating Head and 4AR Wire Line Stripper are companion tools and best results are obtained when they are used together. When used together, they are so compact as a unit, that pipe can be raised and lowered with short bail elevators.

KING 4C CIRCULATING HEAD

The King 4C Circulating Head has a 3" clear opening through it. The spindle can be furnished for any commonly used tool joint pin. The top of the circulating head has a 4" female pipe thread, and the gooseneck a 3" female pipe thread. Bearings are sealed in the housing with a grease nipple provided.

KING 4AR WIRE LINE STRIPPER

The King 4AR Wire Line Stripper is an automatic release type, having a positive latch and a sure release. Bronze rollers guide the line and are equipped with grease nipples for lubrication. Rubber strippers are inserted from the sides and can be renewed while the line is in the hole. This tool is non-sparking which lessens the fire hazard.

For Swabbing Use KING Type 3AR Wire Line Stripper

See pages 2129 to 2140, Volume 1, in 1948 Composite Catalog for other King Oil Tools.
All prices F.O.B. Houston, Texas, and subject to change without notice. — Order through your Supply Store.

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KING OIL TOOLS

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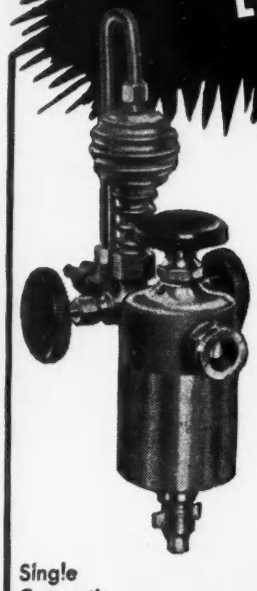
HOUSTON 10, TEXAS

STEAM CYLINDER LUBRICATORS



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SWIFT LUBRICATORS

For years have been widely used by the oil producing and refining industry for cylinder lubrication on steam-driven slush pumps, boiler feed pumps, drilling engines and other similar equipment.

Simple, dependable and inexpensive, Swift Lubricators are especially suitable for use in cold, exposed weather service. The famous Swift bullseye sight-feed tells at a glance the rate of oil feed. This style of sight-feed eliminates leakage, repacking and glass breakage common with the tubular glass types.

Available in ½ pint, 1 pint and 1 quart sizes in both single and double-connection styles. Your supply house has them or can secure them for you.

SWIFT LUBRICATOR CO., INC.
27 Home Street, Elmira, N. Y.

here's a better way to prevent mud losses!

Yes—operators are discovering the greater effectiveness of certain basic fibrous raw materials manufactured by Wood Conversion Company. These materials—composed of clean, chemically treated new wood fiber—are unusually successful in preventing mud losses through fissures or porous formations. Manufactured under rigid inspection, K-25 Industrial Fiber is easily mixed with the mud and stays in suspension indefinitely . . . does not rot or deteriorate. Shipped in bales, K-25 Industrial Fiber is easily handled. For full information and liberal samples, write Wood Conversion Company, Dept. 201-28, First National Bank Building, St. Paul 1, Minnesota.

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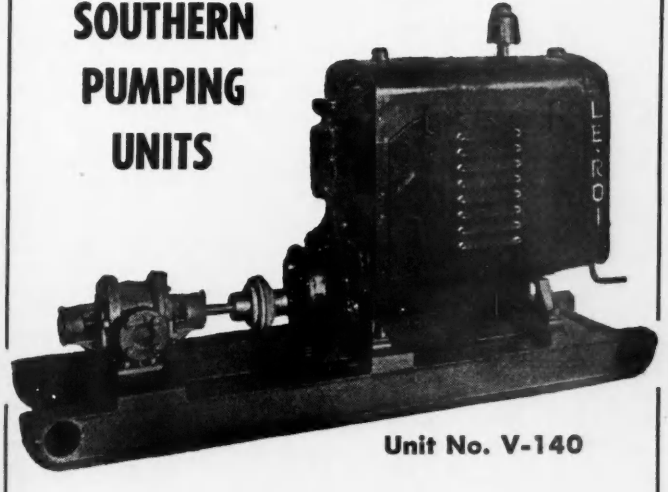
SOUTHERN PUMPING UNITS



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Le Roi Power Unit — Viking Pump Capacity 140 barrels per hour.

Complete units and replacements in Houston and Kilgore stocks.

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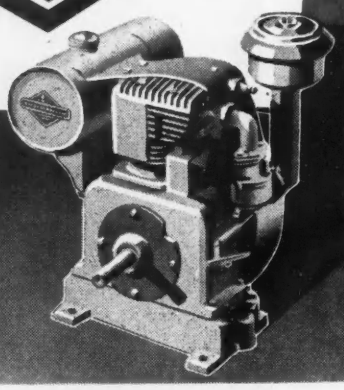
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES



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AIR COOLED POWER

The record for dependable performance... made by more than 3¼ million Briggs & Stratton engines built during 28 years of *continuous production*... stands unequalled. No other manufacturer has built so many 4-cycle air-cooled gasoline engines, or has had such long experience in building them. This experience, and the proven ability to deliver maximum performance year after year—maintain Briggs & Stratton engines *as the foremost power value* for industrial equipment, farm machinery and appliances.

BRIGGS & STRATTON CORPORATION, MILWAUKEE 1, WIS., U. S. A.

MEN IN THE INDUSTRY NEWS

Hugo A. Anderson of Chicago has been elected a director of Warren Petroleum Corporation, succeeding **J. H. Boyle,** who resigned as an officer and director. Anderson is general vice president of the First National Bank of Chicago and an authority on the financing of production, refining and distribution.

»

John L. Leeper, Oklahoma City, has been made tool pusher and manager of tools for **A. R. Jordan** of Hugo, Okla., and will operate out of Oklahoma City.

»

Mike Hamilton has been named geologist for Faultline Oil Company. He recently spent two years in South America and was a consulting geologist at Fort Worth before joining Faultline.

»

William P. Morrison has been named manager of Davon Oil Company's land department, succeeding **Ross Mayo** who will operate as an independent.

»

George W. Southworth, formerly of Kansas City, Mo., has joined Warren Petroleum Corporation at Tulsa as distribution manager for its Liquefied Petroleum Gas Division.

»

William H. Kershaw, assistant general sales manager of The Texas Company, has retired after 37 years with the company. Born in Bridgeport, Conn., in 1883, Kershaw began his career with the eight-year-old Texaco organization in 1910 as a road engineer.

»

John E. Mabee, Tulsa, Okla., oil man and philanthropist, was inducted into the Oklahoma Hall of Fame at Statehood Day observance ceremonies in Oklahoma City. He is a pioneer oil man.

»

Joe A. Laird, previously associated with **George W. Strake,** independent oil operator of Houston, as petroleum engineer and geologist, has opened offices at 1618 Cherryhurst Avenue, Houston, as an independent and geological consultant. Laird graduated as a petroleum engineer from Texas A. & M. College and received his master's degree in geology from the University of Oklahoma. Before joining Strake he was district petroleum engineer for the Texas Railroad Commission in Houston, and petroleum engineer with **Jo H. Cable** of Cable & Stine, consulting engineers, in Wichita Falls, Texas.

»

W. L. Ducker, Tulsa engineer, has been named professor of petroleum engineering at Texas Technological College. Ducker has been active in the oil business for 15 years, having been associated with Barnsdall Oil Company, Seismograph Service Corporation, Engineering Laboratories, Inc., Bovaird Supply Company and, recently, in private consulting practice.

»

R. J. Sullivan, formerly with The Carter Oil Company, has been elected president of Inland Producers, Inc., with headquarters at Mattoon, Ill.

DEATHS

Jess R. Scarborough

Jess R. Scarborough, 58, vice president in charge of the land department for Mid-Continent Petroleum Corporation, died at Tulsa, December 26, after suffering a heart attack. He was one of the oldest employes of Mid-Continent from point of service, having been connected with the old Cosden Oil and Gas Company which was taken over by Mid-Continent in 1921. He resided in Tulsa since that time.

»

Harry Hollenback, Oklahoma independent oil operator, died December 20 at Oklahoma City following a brief illness. During the past 15 years he had participated in most of the new plays in the state and was one of the most active independent wildcatters in the Mid-Continent area.

»

Bradford Foote, Sr., pioneer gear manufacturer, died November 19. He founded the Brad Foote Gear Works in 1924 and was president and treasurer of the firm at the time of his death.

»

B. E. Horrigan, 71, of Tulsa, died January 10, following an extended illness. Horrigan was called the "Will Rogers of Tulsa" and was known for his wit. He was born in Corry, Penn., and went to Oklahoma shortly before statehood as field manager for the Kansas Torpedo Company. An authority on explosives, Horrigan later became affiliated with the Eastern Torpedo Company and later was associated with American Glycerine Company.

»

L. D. Lutton, 63, veteran employee in the accounting department of Phillips Petroleum Company, Bartlesville, Okla., died January 9 at his desk following a heart attack. He was born in Clifton, Ill., and was due to retire next year after 30 years with Phillips.

»

George L. Bascom, 80, retired oil man and a Tulsa resident since 1905, died January 9, following a heart attack. He was a native of Bradford, Penn., and was active in the Pennsylvania and Oklahoma oil fields.

»

David Kennedy, 74, veteran attorney and oil operator of Tulsa, died January 5, while on a business trip to St. Louis. He had resided at Okmulgee, Okla., from early in 1920 until 1932, when he moved to Tulsa to engage in various oil activities.

»

Gordon L. Scheig, 47, oil operator, died at San Antonio December 20. He had lived there since 1936 and was in partnership with his brother, **R. F. Scheig.** He was a native of McAlester, Okla.

»

Harold D. Lannon, 78, of Bartlesville, pioneer Oklahoma oil operator, died December 22, at Tulsa after an extended illness.

A. W. Plant, 56, former division manager for Phillips Petroleum Company died December 17 at Tulsa after a brief illness. A native of Joplin, Mr., he went to Tulsa from Denver in 1931 as division manager, but resigned three years later to enter another line of business.

»

L. J. McMillen, 85, retired Tulsa oil operator, died December 14, at Siloam Springs, Ark., after a brief illness. He was born in Pennsylvania and went to Oklahoma in the early 1920's.

James P. Neilson, 82, Oklahoma oil man, died December 9, at Tulsa after a long illness. A native of Edinburgh, Scotland, he had resided in Tulsa for 38 years and had been active in the oil field equipment manufacturing field for about 45 years. During World War I he was superintendent of the Roxana Petroleum Corportaion refinery at Cushing, Okla. He also had been superintendent of the Paul Arbon Company and the McGraw, Baughman and Bearly Derrick Company, later being associated with a son, **Albert H. Neilson,** oil well equipment manufacturer.

»

Horace H. Jorgensen, 46, credit manager for Derby Oil Company, died December 21 following a heart attack at Wichita, Kansas.

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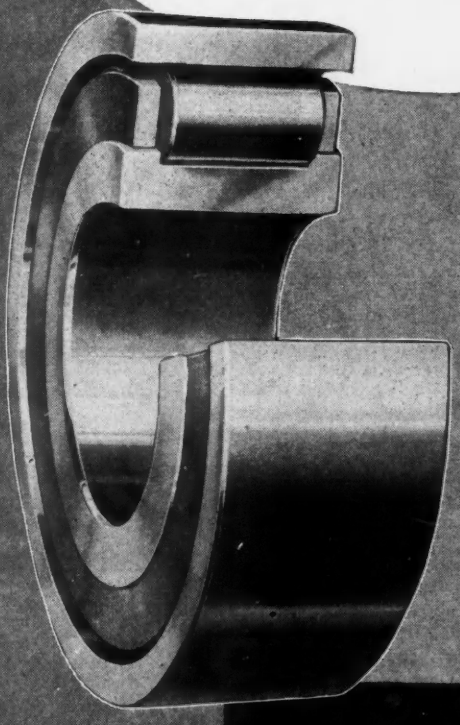

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Furnished in 5 styles, 6 S.A.E. series and 85 sizes. Special designs also available. Write.

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MANUFACTURERS' AND SUPPLIERS' NOTES

International Harvester Makes Changes in Branch Personnel

W. K. Perkins, manager of sales, International Harvester motor truck division, has announced the following changes in branch personnel:

E. P. O'Connor has been promoted to assistant branch manager of the Minneapolis motor truck branch. O'Connor, formerly retail truck manager, San Francisco, started his career with Harvester at St. Cloud, Minn., in 1933. Since that time he served in various sales capacities in Eau Claire, Wis., and Fargo, N. D. During the recent war, O'Connor served in the European theater in the Transportation Corps and attained the rank of major.

Merion Young, formerly retail truck manager at Portland, Ore., has been promoted to assistant manager at the Seattle motor truck branch. Young started with Harvester at Portland in 1929 and has served as retail and wholesale salesman and more recently as retail manager at that branch.

Depend on GORMAN-RUPP

Lightweight **PUMPS**

1½ inch

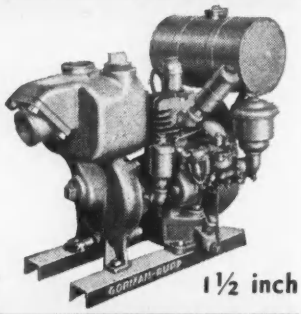
Gorman-Rupp self-priming centrifugal pumps are especially designed to meet the toughest requirements of the oil fields. A product of advanced engineering design, yes -- but retaining the same simplicity of construction that has made Gorman-Rupp so outstanding in other fields.

The applications of these pumps around a lease are too numerous to mention. You can get a Gorman-Rupp in any size or capacity to suit your particular requirements.

Gorman-Rupp guarantees satisfaction. No other pump on the market will do more work for its size, power or weight, or for as long a period of time without attention or maintenance. Every pump tested.

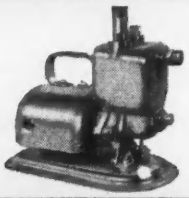
Ask for further information and special pump bulletins.

FOR LARGE CAPACITY
THE "MIDGET"
Wt. 62 lbs. -- 5500 GPH



1½ inch

FOR HIGH PRESSURE
MODEL 1103
Wt. 60 lbs. -- 3600 GPH



¾ inch

FOR LIGHT ALL-PURPOSE
THE "HANDY"
Electric motor driven
Weight 20 lbs.--1000 GPH

Mid-Continent Oil-Field Representative

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HOUSTON 2, TEXAS

THE GORMAN-RUPP COMPANY
349 NORTH BOWMAN ST., MANSFIELD, OHIO

Appointment of Three Key Men Announced by Mission Company

Mission Manufacturing Company of Houston has promoted three men in key posts, according to President Dudley C. Sharp.

A. L. Jacobs

A. Lewis Jacobs has been made purchasing agent, Paul Franks assistant purchasing agent, and Robert Anschutz head of the Cost Accounting Department.

Jacobs moved into the post vacated several months ago by promotion of Jeff Tucker to export sales manager for Mission, with offices in New York. Franks, who has been a buyer in the purchasing department, is Jacobs' assistant in that department now. Anschutz, formerly a cost accountant, replaces Jacobs as head of the cost accounting department.

A native of Kennedy, Texas, Jacobs is a graduate of the University of Texas and a veteran of four years with the Navy. He has been with Mission since 1936. Anschutz is a graduate of Baylor University, Waco, and served for more than four years with the Army.

W. A. Miller Named Secretary And Treasurer of Lane-Wells

W. A. Miller has been elected secretary and treasurer of Lane-Wells Company, succeeding Miss B. G. Peters, who has retired after 15 years of service.

Miller joined Lane-Wells in 1945 after 5½ years service in the Army Air Force, where he attained the rank of major. He has been chief statistician since January 1, 1946. In addition to his new duties as secretary and treasurer, he will continue to head the statistical section. Miller will report to D. S. Jeppson, vice president and controller.

Roman F. Arnoldy Elected Head Of Houston Heat Treating Firm

Roman F. Arnoldy has been elected president and general manager of Houston Heat Treating Company.

Arnoldy was formerly a development engineer with Union Carbide & Carbon Research Laboratories and has been active in research and development of flame hardening since 1936. Many flame-hardening installations in the Southwest have been made as a result of his work since moving to Houston in 1939.

McKissick Agent Named

McKissick Products Corporation, Tulsa, has named Harry W. Denton of Midland, Texas, as its sales representative in the West Texas-New Mexico territory. He succeeds the late Tom H. Gutelius.

Peerless Manufacturing Company Moves Into New Plant at Dallas

Peerless Manufacturing Company, Dallas, manufacturers of engineering specialties for the oil and chemical industries, has moved into its new plant, according to E. O. Haltom, new Peerless sales manager. The plant, spread over 20 acres just north of Dallas, has more than 15,000 square feet of factory and office space.

E. O. Haltom

Haltom joined Peerless after 20 years with Wyatt Metal & Boiler Works at Dallas, where he was in charge of sales.

Other officers of the newly expanded company are Mrs. D. A. Sillers, president, replacing her husband, the late Don A. Sillers; J. A. Mundie, former assistant manager of the Chase Bag Company's Dallas plant, vice president; Ray B. Owens, petroleum and chemical engineer, vice president and chief engineer; and Mrs. Mary H. White, veteran Peerless employe, secretary and treasurer.

Plant Manager Is Appointed By Johns-Manville Company

J. L. Miller, production superintendent at the Zelienople, Penn., Johns-Manville factory, has been appointed plant manager. Miller succeeds S. K. Cooper, resigned. Miller joined Johns-Manville in 1934 as a laboratory assistant. Two years later he was promoted to assistant research engineer and in 1938 was advanced to research engineer. He was transferred to Zelienople in 1942 and appointed production superintendent.

Detroit Representative Named By Roebling's Sons Company

John A. Roebling's Sons Company, Trenton, N. J., manufacturers of wire rope and wire products, through E. C. Low, vice president in charge of sales, announced the appointment of L. H. Van Dike, Jr., as Detroit representative, replacing the late Harry T. Hirbe, who died November 24.

Van Dike, a former lieutenant in the Navy is a graduate of Dartmouth College and the Tuck School of Business Administration. He has been associated with the company since 1946.

Hunt Takes Over Manufacturing, Distribution of Roofe Product

Purchase of exclusive manufacturing and distribution rights to the Roofe Swivel Joint, in domestic and foreign fields, was announced by Hunt Tool Company, Houston.

T. N. Hunt, president of Hunt Tool, said his firm has taken over the entire production of the Roofe Swivel Joint along with some shop production equipment and shop personnel of the Roofe Company.

Additional new specialized production equipment will be purchased and installed immediately in order to greatly increase output of the Roofe Swivel Joint for the oil industries, Hunt said.

Sales of the Roofe Swivel Joint in domestic fields will be handled through Hunt Tool Company. Export sales will be handled by Hunt Export Company, with offices in Houston, New York, Buenos Aires, Port of Spain, and Mexico City.

Roofe Swivel Joints have been used throughout the oil industry for more than two years. The joint features a patented packing and bearing design that makes it easy to assemble or disassemble on the derrick floor, a full size streamline bore through the joint, specially designed packing chamber that permits lubrication under pressure, and a bearing area that assures perfect alignment of all working parts.

Goodrich Manager Named

Philip H. Zuiderhoek has been named factory manager of the Tuscaloosa, Ala., plant of The B. F. Goodrich Company.

ILLUSTRATED: Rotary Table Bearing. 33" Outside Diameter, 3" balls, 200 ton capacity.

Seems the only outspoken word for it

Take a ringside seat at oil drilling rigs and watch Aetna bearings slug it out . . . in rotary tables, crown blocks, swivels... in the toughest bouts bearings can face in the oil fields.

You'll agree "guts" seems the only plain-spoken word for the great fighting hearts they have.

Building special bearings, with maximum fighting capacity, is a basic business with us—has been for nearly a third of a century. As specialists in ball thrust bearings, our plant is geared for every thrust bearing need of the oil drilling industry.

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Standard and Special Ball Thrust Bearings • Angular Contact Bearings • Special Roller Bearings
Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings

C. W. Haseltine, Vice President Of Mack Trucks, Inc., Retires

Ending a 35-year career with Mack Trucks, Inc., C. W. Haseltine, vice president, secretary and treasurer of that organization as well as director of Mack Manufacturing Corporation, manufacturing subsidiary, has retired.

A native of New Paris, Ohio, Haseltine joined Mack as a bookkeeper and statistical clerk in 1912, just 12 years after Mack built and sold its first vehicle.

F. W. Sommer was named treasurer and T. V. Homan, secretary of the company.

Sommer, formerly assistant secretary and assistant treasurer of Mack Trucks, Inc., joined the organization in 1922 as clerk in the note department. Following a period as division note department head in Mack's Philadelphia office, he returned to headquarters in 1925 to become note auditor. In 1936 the duties of assistant treasurer became his province, with those of assistant secretary being added in 1941.

Homan joined Mack in 1912 as clerk in the auditing department. He was appointed assistant treasurer in 1918 and assistant secretary in 1921, and has served continuously in those capacities.

KEEP ALGAE OUT!

WITH A Paddock HIGH-CAPACITY CHLORINATOR

The Paddock High-Capacity Chlorinator is a rugged guardian of cooling systems and pipe lines. Keeps out destructive algae and other harmful bacteria. Operates on high vacuum principle . . . no float boxes or float valves to replace or repair. All parts of silver, glass or plastic, impervious to chlorine. Can handle up to 1,000 pounds per 24 hours—within 4% positive control.

Ask about SURECLOR — small unit for temporary camps.

For specifications, write to

Paddock Engineering Co. of Texas

900 S. ERVAY DALLAS 1, TEXAS

J. M. Defee

C. J. McKernan

West Texas-New Mexico Agents Named by Web-Wilson Oil Tools

Web-Wilson Oil Tools, Inc., has appointed J. M. Defee and C. J. McKernan as agents for the sale and servicing of Web-Wilson Oil Tools in the West Texas and New Mexico areas. Headquarters will be at Odessa, Texas.

Defee has had approximately 12 years of oil field experience in the West Texas area, including actual field experience as a roughneck and driller. He was connected with the Green Head Bit and Supply Company for approximately three years and for the past year was associated with Patterson-Ballagh in West Texas.

McKernan formerly was with Wilson Supply Company in the Gulf Coast area and for the past year has been with Patterson-Ballagh in West Texas. He spent 3½ years in the Army Air Corps and was discharged as a captain.

Universal Atlas Cement Names Advertising Bureau Manager

Appointment of Joseph A. Sullivan as manager, Advertising Bureau, Universal Atlas Cement Company, was announced by George H. Reiter, vice president of this U. S. Steel subsidiary. Sullivan also has been appointed director of public relations. He succeeds the late Max A. Berns, publicity manager.

Well Equipment Manufacturing Sales Representatives Meet

Sales representatives of Well Equipment Manufacturing Corporation held a three-day meeting at the Houston plant at which they discussed Okadee and Anchor products, G. R. Winder, WECO vice president and sales manager, announced. WECO is oil industry distributor for these products.

W. H. Stewart, president of Anchor Burner Company, Oklahoma City, attended the meeting.

Mack Names Manager

Harold J. Fikejs was named manager of Mack Truck Company's Milwaukee Direct Factory Branch. Fikejs, who at 31 is one of the youngest men in the company's history to hold a branch managership, has served Mack as truck salesman and district wholesale manager at the Des Moines branch since he joined the company in 1946, following four years in the Army.

B. V. Fisher Appointed Sales Manager of Delaney Company

The Delaney Company, Houston, has announced the appointment of B. V. Fisher as sales manager of its oil field division.

B. V. Fisher

Fisher recently vacated the position of executive vice president of Oil Center Tool Company, which he served in various executive positions for 11 years. Prior to that time he was connected with the Continental Supply Company and the Westcott Valve Company.

Aid to Graduates for Research Work Is Again Offered by G-E

Aid to college and university graduates who wish to undertake or continue research work in scientific and industrial fields was announced by General Electric Company for the 24th consecutive year.

Applications are being accepted for the scholastic year 1948-1949 for grants under the $1 million G-E Educational Fund, from the income of which the fellowships are awarded, according to W. W. Trench, company secretary and chairman of the Education Committee.

Applications for the fellowships, which must be filed by January 1, have been distributed to libraries of engineering schools, department heads of electrical and mechanical engineering schools, professors of electrical and mechanical engineering, physics, chemistry and metallurgy, and deans of graduate schools.

The Charles A. Coffin Fellowships are awarded in the fields of electricity, physics, and physical chemistry. The Gerard Swope Followships, first granted in 1946, are awarded in fields of industrial management, engineering, physical sciences, and any other scientific or industrial field.

Ideco Representative to Conduct Study of Offshore Operations

International Derrick and Equipment Company has engaged Charles F. Cisler of Marietta, Ohio, to make a study of offshore drilling operations. Particular attention is now being directed toward the proper application of sea floor foundations and involved engineering problems.

Charles F. Cisler

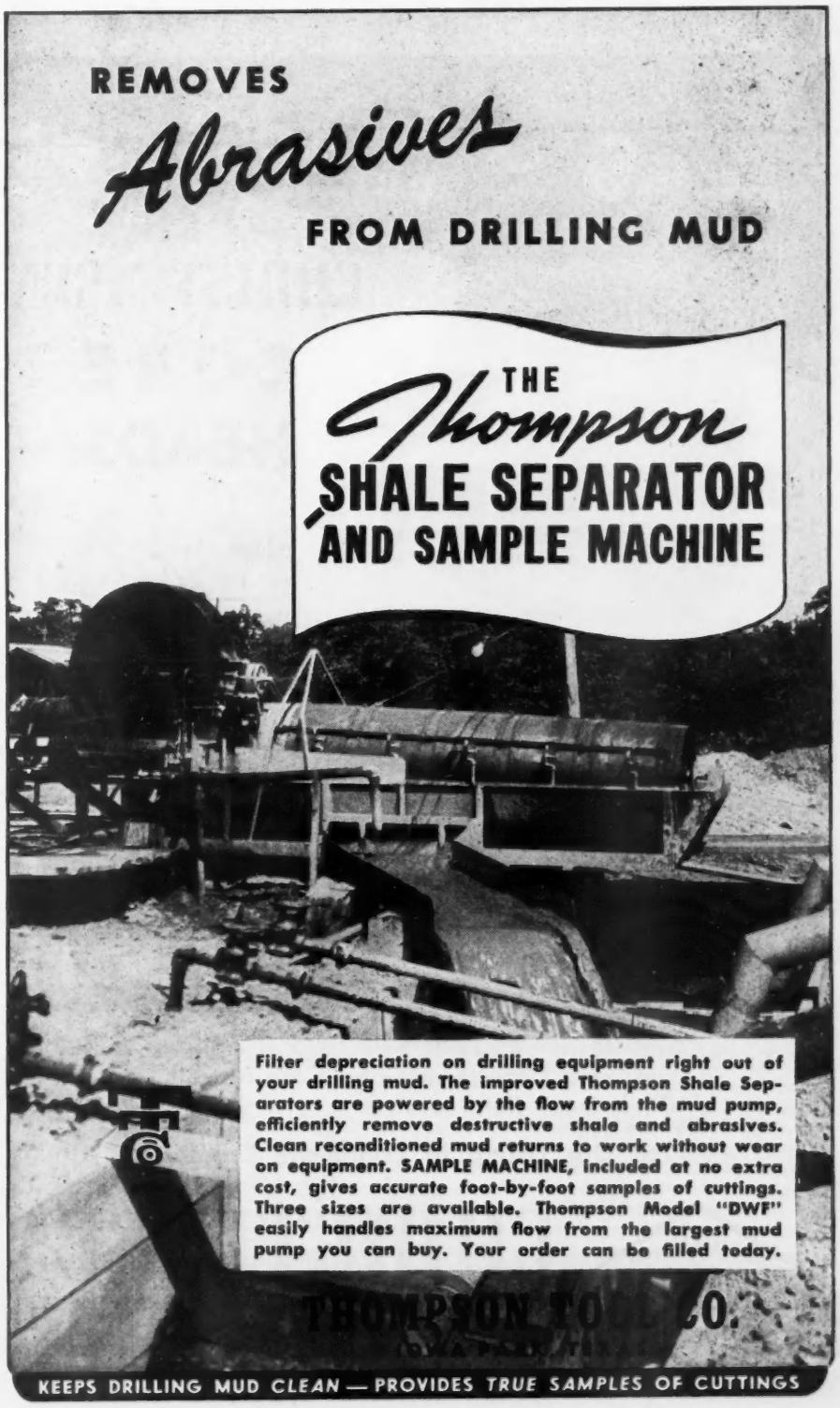
Cisler was born at Marietta, Ohio, where he entered into general construction work with the family firm. He soon became a junior partner.

Previous to World War II, Cisler's construction firm was engaged in railroad, street, and highway work, as well as river dredging, lock, and dock construction on the inland waters of the Mid-Eastern states. During the recent war, he offered his services to the U. S. Army, Corps of Engineers, and was assigned to General MacArthur's staff in the chief engineer's office.

Cisler will spend time in the Gulf Coast area, observing offshore operations and discussing phases of the problem with engineers associated with the work.

Sales and Executive Personnel Promotions Made by Bethlehem

Bethlehem Supply Company announced the following promotions: W. A. (Babe) LaRew, formerly special representative at Odessa, Texas, to assistant manager of the West Texas-New Mexico district with headquarters at Odessa; E. R. Phillips to special representative on sales and service for the entire Illinois district; T. H. Anderson, formerly pump shop operator and floorman at Sundown, Texas, to field representative at Sundown.

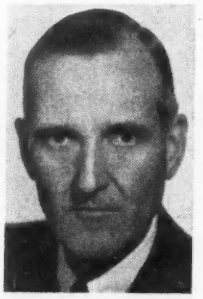

REMOVES
Abrasives
FROM DRILLING MUD
THE
Thompson
SHALE SEPARATOR
AND SAMPLE MACHINE
Filter depreciation on drilling equipment right out of your drilling mud. The improved Thompson Shale Separators are powered by the flow from the mud pump, efficiently remove destructive shale and abrasives. Clean reconditioned mud returns to work without wear on equipment. SAMPLE MACHINE, included at no extra cost, gives accurate foot-by-foot samples of cuttings. Three sizes are available. Thompson Model "DWF" easily handles maximum flow from the largest mud pump you can buy. Your order can be filled today.
KEEPS DRILLING MUD CLEAN — PROVIDES TRUE SAMPLES OF CUTTINGS

M. F. Hazel Appointed General Manager of Sales for Oilwell

Appointment of M. F. Hazel of Dallas as general manager of sales for the Oil Well Supply Company, U. S. Steel subsidiary, was announced by Lloyd E. Tracy, sales vice president.

K. B. Winstead, also of Dallas, was named assistant general manager of sales, with headquarters at Dallas. V. J. Waters was named manager of the Central Midwest division with headquarters at Dallas. C. A. Bell was appointed manager of drilling equipment sales, also with headquarters at Dallas.

Hazel, a native of Bellefonte, Penn., and a graduate mechanical engineer from Penn State College, became associated with Oil Well Supply in 1930 as service engineer. From 1930 until 1943, he served in various capacities in East Texas and Oklahoma, becoming sales manager for both the West Texas and the East Texas-North Louisiana-Arksas District. In 1941, he was assistant division manager at Houston. In 1943 he entered the Navy with the rank of lieutenant. He returned to Oil Well in 1946 as assistant to the vice president. Hazel will be responsible for coordinating sales activities of the domestic and export divisions and the tubular department.



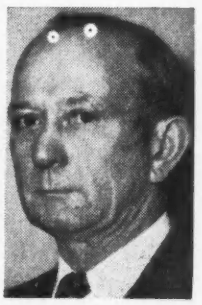
K. B. Winstead

M. F. Hazel

Winstead, a native of Weatherford, Texas became connected with Oil Well in 1921, and has been located at Fort Worth, Breckenridge, Wichita Falls, and at Dallas. He has served in various capacities. In 1946 he became manager of the then Central Midwest division.

Waters, a native of Hartford City, Ind., joined Oilwell in 1919. He has served at Cushing, Wynona, Bryant, Shidler, Okmulgee, Wewoka, and Tulsa, Okla., and has been stationed at Dallas since 1932.

V. J. Waters



C. A. Bell

Bell, native of Mississippi, began work with Oilwell in 1924. He has been associated with the company at Stroud, Seminole, Maud, Wewoka, and Earlsboro, Oklahoma, and at Houston and Dallas.

Promotions Are Announced by Bethlehem Supply Company

Bethlehem Supply Company announced the following promotions: T. W. Teague, formerly at the Winnsboro, Texas, store, to field representative at the Shreveport store, succeeded by N. E. Formby; B. K. Smith, formerly special representative in the used material department at Kilgore, Texas, transferred to the Corpus Christi, Texas, district office and promoted to field representative for general equipment sales.

E. M. Siette at the New Iberia, La., district office and store, H. L. Daniels at the Lake Charles, La., store and L. E. Garner, Jr., at the Hobbs, N. M., store, have been promoted to field representatives and will operate from their present stores.

H. C. Smith Official Moves

Elmer R. Smith, sales and service engineer for the H. C. Smith Oil Tool Company throughout South America, has returned from a two-month trip to the U. S. Previously headquartered at Bogota, Colombia, he has just moved his offices to Caracas, Venezuela.

LESS COST PER FOOT with CHRISTENSEN CORE HEADS

The 1-2-3 of Christensen Core Heads

1—Fewer Round Trips

2—Faster Drilling

3—Greater Core Recovery

That's the **proved** performance of Christensen Diamond Core heads. In field after field, it's performance like this that adds up to

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Christensen engineers and manufactures Diamond Core Heads and Core Barrels. Competent field service.

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CHRISTENSEN DIAMOND PRODUCTS CO.

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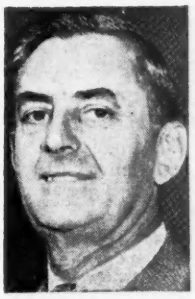
E. A. Longenecker



C. W. Pendock

E. A. Longenecker Becomes President of Le Roi Company

C. W. Pendock has resigned as president of Le Roi Company and has been succeeded by E. A. Longenecker, former president of the Lauson Division of Hart-Carter Company. Pendock was elected chairman of the board.

Pendock has been the only president in the company's history. The designer of many of the company's products, he was a big factor in the firm's growth from a small machine tool shop in 1914 to one of the industry's leading manufacturers.

Longenecker is already familiar with the manufacture of Le Roi products having been in a closely allied industry and also an instructor in engine design at the University of Wisconsin.

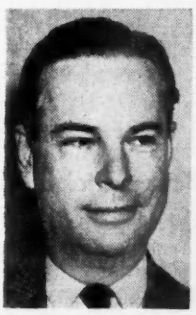
M. W. Cook to Be Representative In Near East for Several Firms

M. W. (Monk) Cook has been appointed Near East Sales and Service Representative for Security Engineering Company, Inc., International Derrick and Equipment Company, Byron-Jackson Company, Patterson-Ballagh and Falcon Products.

He will service all the oil companies in the Near East from Headquarters at Baghdad or Busra, Iraq. Years of practical oil field experience as tool pusher, driller and cementing company salesman and executive in California, Oklahoma and Texas as well as operating formation tester and cementing equipment abroad for the Iraq Petroleum Company eminently qualify cook for his new duties.

M. G. McCool Named General Manager American Iron & Machine Works

The American Iron & Machine Works Company has announced the resignation of Earl W. Miller as general manager. He is succeeded by M. G. McCool as executive vice-president and general manager.



M. G. McCool

McCool has been with the company more than 12 years. He was district manager until the recent appointment.

Two Los Angeles Area Engineers Appointed by Oil Base Company

Oil Base, Inc., Compton, Calif., manufacturers of Black Magic Oil base drilling fluid, has added two service engineers to the staff of field men in the Los Angeles Basin area.

Richard R. White, graduate of Texas A. and M. College, was formerly with Pan-American Petroleum Company as production engineer, later serving as reservoir engineer with Core Laboratories, Inc.

Charles L. Piskac graduated from Nebraska University upon his discharge from the Army Air Transport. Formerly, he served with Nebraska State Highway Division and National Supply Company.

Both White and Piskac will be headquartered in Long Beach, replacing A. E. (Bud) Harris who has been named plant superintendent of the new Oil Base, Inc., plant in Compton. Harris will be in charge of all production and manufacture of Black Magic and allied products.

KEEP YOUR WELLS FREE OF PARAFFIN
HUBER
PARAFFIN SCRAPERS
If paraffin is accumulating in your wells, it will pay you to install Huber Scrapers on your Sucker Rods.
These steel blades, shrink-welded to the rods, clear the tubing wall by a fraction of an inch. Rotated by means of the special rotating rod hanger, they scrape the paraffin from the tubing wall as the sucker rods are rotated and reciprocated. Actually, they make the sucker rod a paraffin scraper.
Users report hundreds of dollars saved by eliminating paraffin removal costs with the installation of Huber Scrapers. Write for detailed records of savings made by the users of Huber Scrapers.
This is the special rod hanger which rotates the rod string. The teeth on the turntable are engaged by two ratchet levers, which are operated by means of a flexible steel cable attached to the walking beam. With each reciprocation, the levers move the rod a fraction of a turn.
ORDER FROM YOUR SUPPLY STORE
HUBER
PARAFFIN SCRAPERS
J. M. HUBER CORPORATION
BOX 831
BORGER, TEXAS

Hinderliter Company to Make 'Nail-It-Kwik' Products Line

Hinderliter Tool Company Division of H. K. Porter Company, Inc., Tulsa., has acquired all manufacturing rights for "Nail-It" pipe couplings, "Nail-It" mud guns, "Nail-It" swivel joints and pump suction couplings.

George Hayes, general manager of Hinderliter Tool Company, also announced that manufacture of these products will begin immediately at the Hinderliter's Tulsa works under the new trade name of "Nail-It-Kwik."

This new coupling principle and sealing method is said to be among the fastest types of couplings yet devised. The halves of the unit are coupled by driving common nails into mating grooves in the male and female ends and are uncoupled by merely pulling the nails. Two or more nails are used on each coupling to form a removable steel shear ring of greater strength than a regular line pipe joint.

To Our Friends in the Exploration Industry

Thanks . . .

Your acceptance of our replaceable blade bits during 1947 was indeed gratifying and we wish to take this opportunity to express our appreciation.

It has always been our aim to furnish equipment that would provide *greater service per dollar invested* than any competitive equipment and our sales records reveal that this was accomplished during 1947. Not only was the entire year better than any previous one, but each succeeding month showed a substantial increase over the month preceding.

Because an extensive development program kept us in the shop much of the time, we know that this increase was *not* due to our sales efforts . . . it was due to increased bit efficiency and performance and to your kindness and willingness to cooperate during our efforts of development. The equipment which resulted . . . the improved, all-purpose "Rock Cutter" Blades . . . further lowered your "bit costs per foot drilled" and fulfilled our pledge to you.

In 1948, we hope to introduce other equipment that will further reduce your operating costs . . . with your splendid cooperation, we feel that this will be accomplished.

Herb J. Hawthorne

5003 North Shepherd HOUSTON, TEXAS P. B. Box 7299

Three Vice Presidents Elected By Chain Belt Company Directors

L. B. McKnight, who joined Chain Belt Company of Milwaukee in 1927, has been elected vice president with executive responsibility for the two heavy machinery divisions, Conveyor and Process Equipment and the Construction Machinery. McKnight was executive assistant to the president of the company and previously was manager of the Conveyor and Process Equipment division.

L. B. McKnight

O. W. Carpenter has been elected a vice president in charge of finance. He formerly was secretary-treasurer and a director of the Kearney and Trecker Company, and went to Chain Belt Company in 1943.

B. F. Devine, also elected a vice president, started with Chain Belt in 1909. He served as sales manager of the Construction Machinery division, and later as manager of that division. He will continue as manager of the Construction Machinery division.

Chain Belt manufactures chains for conveying and power transmission; all types of conveyors and specialized process equipment; and construction machinery. It operates plants in Milwaukee and West Milwaukee, Wis., and Springfield and Worcester, Mass.

Corpus Christi Representative Announced by Oil Well Supply

Donald F. Greenlaw has been named Oil Well Supply Company representative to serve the Corpus Christi, Texas area.

Greenlaw, transferred from San Antonio, joined "Oilwell" in December, 1945, and served in stores at Alice and Pettus, Texas, until January, when he was transferred to the Oil City plant for a student engineering training course.

West Texas-New Mexico Agents Appointed by Falcon Products

James Defee and C. J. (Chili) McKernan have been appointed West Texas-New Mexico representatives for Falcon Products, Inc., according to Vice President H. F. Schlittler. Other recent appointments: E. L. Oliver in Oklahoma and Kansas, E. L. (Cotton) McGee in South Louisiana and Mississippi, and Dean Hallam in East Texas, North Louisiana and Arkansas.

Bank Official Takes Office

J. Lewell Lafferty has become a vice president of the Republic National Bank of Dallas, Fred F. Florence, president has announced.

Lafferty's election to the office was announced in October.

Jack Clemens

Mutt Donovan

Clemens and Donovan Assigned New Posts by Martin-Decker

Jack Clemens, who has just returned from a six and one-half months' South American trip, and Mutt Donovan, Martin-Decker factory engineer who has been stationed in Texas and Louisiana, have completed an intensive study of product development at the Martin-Decker Plant in Long Beach, Calif.

Clemens is now stationed at Houston, where he will assist Gulf Coast customers in the use of Martin-Decker products. Donovan is servicing the Mid-Continent from headquarters at Oklahoma City.

Maltese Cross Water Hose Again Being Made by Hewitt Rubber

Hewitt Rubber Division, Hewitt-Robins Inc., announced that Maltese Cross water hose again is in production after being withheld from manufacture during the war because of government restrictions on the use of premium quality materials.

J. H. Hayden, vice president in charge of sales, revealed that availability of a quantity of selected long staple cotton has enabled Hewitt to return to its list of quality products this prewar brand of hose.

Western Division Parts Manager Named by Caterpillar Company

Herman F. Haven has been appointed Western Division parts manager for Caterpillar Tractor Company.

Herman F. Haven

Haven advanced through many supervisory positions since joining Caterpillar in 1942 as an order interpreter. He became assistant Western Division parts manager in 1945, parts technical manager in 1946 and manager of the Parts Publication Division in April, 1947.

He succeeds Eldon Mason, who resigned to become general parts manager for Holt Brothers, Caterpillar distributors with offices at Stockton, Lodi and Tracy, Calif. W. E. Doersam continues as assistant Western Division parts manager.

M. O. Johnston, Jr., Assumes New Post With Johnston Service Firm

M O. Johnston, Jr., is now in charge of outgoing and incoming supplies and equipment at the M. O. Johnston Oil Field Service Corporation main office and plant at Los Angeles.

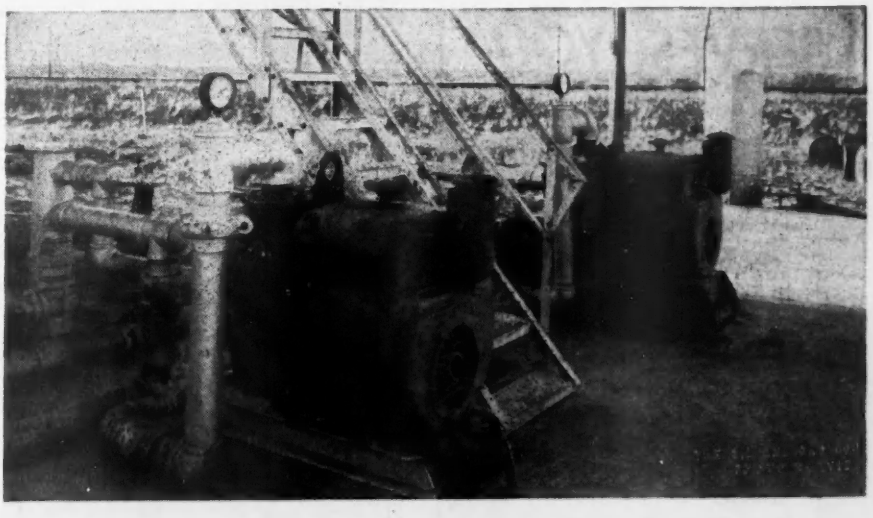
After graduating from Southern Methodist University, Johnston spent some time with the Johnston Corporation at Los Angeles. During the war he served in the Marine Corps and saw action at Guadalcanal, Saipan and Guam. At the end of hostilities he returned to the corporation's employ and recently has been on a leave of absence taking specialized business training preparatory to assuming his new duties.

Goodrich Manager Named

P. W. Stansfield has been named manager of passenger car tire sales of the Replacement Tires Sales division of The B. F. Goodrich Company. He succeeds W. E. Ireland, recently appointed merchandise manager of the International B. F. Goodrich Company.

CMC PUMPS

Utility Dual Prime Model 420
4" Pump — 20 H. P.



These two Model 420 Pumps loading Lub-Oil down in Texas is typical of the many services rendered by CMC Pumps for the oil industry. Ask our engineers to help you with your specific pumping problem.

CONSTRUCTION MACHINERY CO'S.

Specializing in High Pressure centrifugals, Dual Prime centrifugals and Diaphragm pumps for the oil fields.

WATERLOO, IOWA

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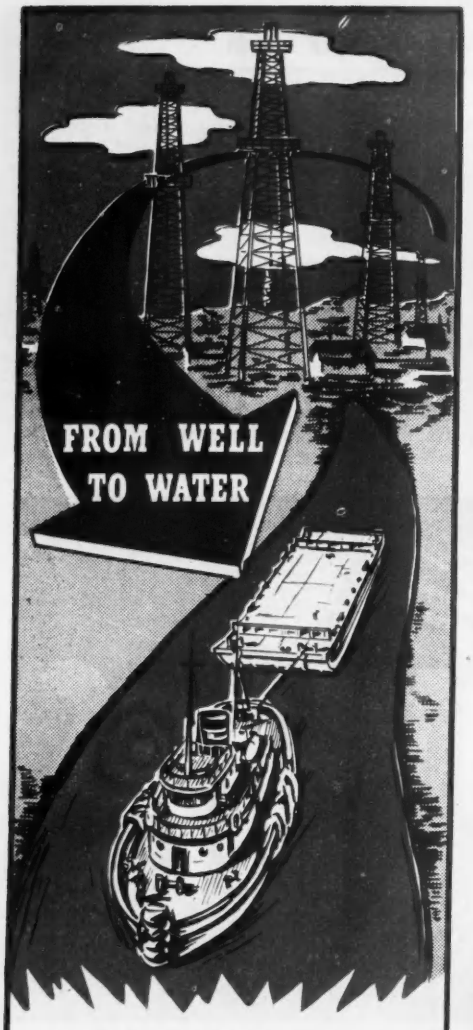

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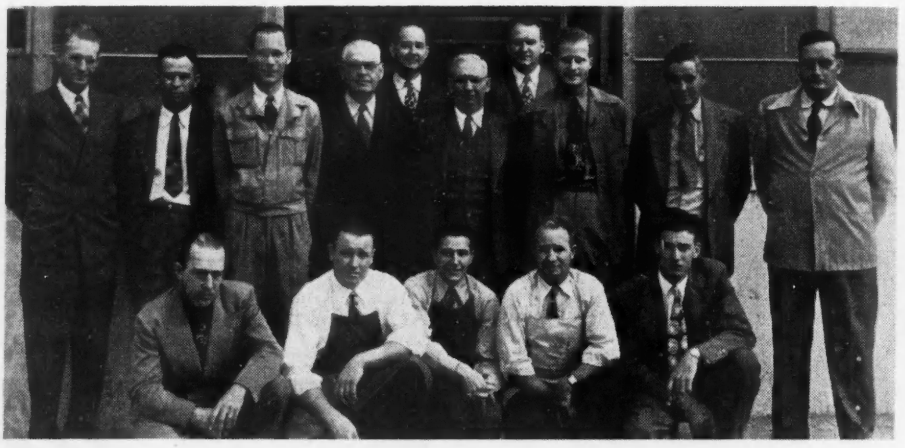


CAMCO HOLDS SALES MEETING—Camco, Incorporated, Scanlan Building, Houston, held its first general meeting of personnel in an all-day session at Houston. After the meeting a banquet was held for company personnel and their wives. Pictured, top row, left to right, are J. B. Richards, gas lift engineer, Midland, Texas; L. P. Conner, gas lift engineer, Monahans, Texas; William M. Edwards, Houston office; R. E. Morgan, vice president, Houston; E. K. Watters, general manager of Texowell Service and Machine Company, manufacturer of Camco equipment; Paul R. Mills, president and general manager; J. H. Howard, chief engineer and secretary; Hal B. Allen, gas lift engineer, Houston; J. H. McCarvell, gas lift engineer, Corpus Christi, Texas; J. T. Patton, gas lift engineer, Corpus Christi. Lower row, Walter H. Seyffert, Jr., assistant sales manager; Derris H. Gaines and Leo T. Jones, shop personnel; Walter E. Graham, shop superintendent; and Howard H. Moore, Jr., gas lift engineer, Lafayette, La. Personnel not in the picture are Leslie L. Cummings, gas lift engineer, Houston; and Vernon T. Richey, gas lift engineer, Lafayette.

SPARTAN UNIT—This is Spartan Tool and Service Company's first oil well cementing unit as it left the Houston shop early in January.

Spartan Tool and Service Firm Completes First Cementing Job

The first oil well cementing job was completed in early January by a concern whose organizers started with an idea just six months ago and are now heading a thriving firm of 75 employes.

The company is Spartan Tool and Service Company, with headquarters in Houston, whose president is C. P. Parsons, and the cementing job was at Victoria on a well owned by John Coffee of Houston and drilled by Lon H. Cron and Son, Houston contractors. H. F. (Blackie) Clark, vice president in charge of field operations for Spartan, supervised the successful operation, which required 525 sacks of cement. Wayne Dodson was the cementer and Leroy Shook represented the Spartan engineering department.

Spartan's executive staff is filled with men who have spent life-times in the cementing business. In addition to Parsons and Clark, officers are Turner Briggs, vice president in charge of sales; and William H. Quinette, secretary-treasurer.

Initial capitalization of the firm was $3½ million. Its main offices are at 2101 Esperson Building and the main plant is at 2101 Old Spanish Trail. Two and one-half million dollars are being expended for equipment which will be assembled at the main plant.

Parsons has been in the oil business 29 years. After serving in World War I, he was with Magnolia Petroleum Company until 1929, becoming district superintendent in charge of drilling and production in Southern Oklahoma. He then went with Halliburton Oil Well Cementing Company as chief field engineer and also was a director of the company. He was manager of sales from 1932 to 1935 and vice president in charge of sales and a member of the executive committee from 1935 to 1946. He left Halliburton in 1946 to become a vice president and sales consultant for Hughes Tool Company, and in May, 1947, he resigned to devote his time to the organization of Spartan. From early 1944

to mid-1945, Parsons was on leave of absence to serve as director of materials for PAW. Since 1946 he has been chairman of the Scarce Materials Committee of the National Petroleum Council.

Clark was with Halliburton from 1926 to 1945. When he left the firm he was a division superintendent in charge of operations in the Gulf Coast area. He then went into the oil well testing tool business and until the organization of Spartan was president and director of Perfo-Test, Inc., and vice president and director of Hunt-Clark Company.

Briggs started with Halliburton in 1933 and was credit and sales manager for the Gulf Coast division when he resigned in 1947 to become president and director of Houston Foreign Trade Import Company and director of Houston Export Company.

Quinette has been engaged in accounting and tax matters for 25 years. For the past 20 years he was with the accounting firm of Peat, Marwick, Mitchell and Company at Tulsa, Denver and Houston.

In addition to oil well cementing, Spartan will operate a fleet of bulk cement trucks, the first of which arrived during January. Plans call for 50 oil well cementing units and 37 bulk cementing trucks. The company is also operating the Perfo-Tester, a combination gun perforator and casing testing device acquired through the purchase of Hunt-Clark Company. Other devices for well servicing are in process of design and manufacture.

Paul E. Fitzgerald Heads New Department Set Up by Dowell

Paul E. Fitzgerald, geologist for Dowell, Incorporated, Tulsa, has been appointed manager of a new foreign sales and export department. Fitzgerald has been associated with Dowell for 15 years and has served in many capacities, including assignments in Mexico, Canada and Venezuela. He will continue as company geologist and also will retain his membership on the board of United Oilwell Service, S. A., Dowell's Venezuelan subsidiary.

Henry H. Paris Distributor, Inc., Is New Name for Houston Firm

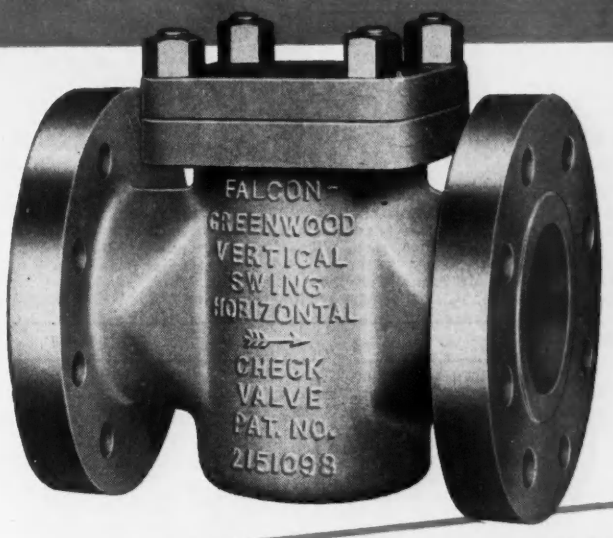
The Houston business formerly conducted by Henry H. Paris Distributor is now known as Henry H. Paris Distributor, Inc. Management and policies will remain unchanged, according to Henry H. Paris, president.

The firm is agent and distributor for W. C. Norris Manufacturer Inc., Wheeling Machine Products Company, The Ohio Injector Company, Harrisburg Steel Corporation, Volcano Burner Company, Oil States Equipment Company and Dresser Manufacturing Division.

California Distributor Named By Standco Brake Lining Firm

Standco Brake Lining Company of Houston has appointed Abegg & Reinhold, Ltd., of 2533-41 East 26th Street, Los Angeles, the sole California distributor for Standco Oil Field Brake Lining.

Another FALCON Product



FALCON-GREENWOOD
VERTICAL SWING
HORIZONTAL CHECK VALVE

HIGH PRESSURE
FREE FLOW NO "CHATTERING"

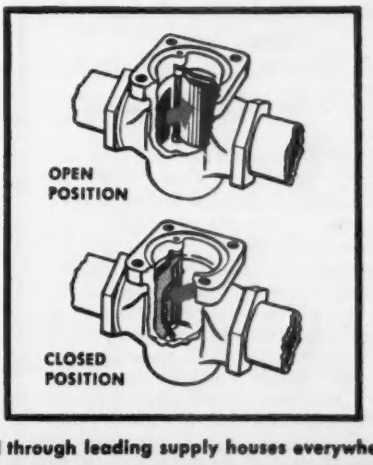
Here's a cast steel high pressure Swing Check Valve for oil, gas, steam and water that will not "chatter" or knock and therefore will outlast ordinary check valves many times.

The gate mounted on a vertical pivot pin does not float on the liquid or gas and its weight therefore is not a factor in closing the valve. NO FLOATING — NO "CHATTERING" — NO WEARING.

When flow ceases or is reversed a flat spring on back of gate forces it closed instantly.

Made of cast steel with large free-flow passage-ways, the Falcon-Greenwood Vertical Horizontal Swing Check Valve is available in sizes from 2" to 8".

Send for Bulletin No. 101



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★ SLUSH PUMP LINERS
★ LINER SLEEVES
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★ SWIVEL WASH PIPES
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Falcon Products are sold through leading supply houses everywhere

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FOR SALE

■ WYOMING Top Production Ranch; 35,000 acres, deeded; 35,000 acres, leased; three sets of improvements. Carry: 4,000 cattle, and 1200 ewes; Hay-Grain crops. Well watered. Seven producing oil wells; small, shallow production. Future possibilities not explored. $125,000 will handle. Request our Select-Choice offerings. DUMKE LTD., 470 South Alcott, Denver, Colorado.

■ For Sale: 36L Bucyrus Spudder with butane tank steel dog house, and tools from 12½" down. Cardwell "R" & "K" spudders with steel dog houses, butane equipment, and with 7" and 5" tools Star spudder with 7" and 5½" tools. All in A-1 condition. Box 422, Mt. Vernon, Illinois.

■ Sullivan core drill, model 22 H.D. with Case engine, mast, 10-ft. corebarrel, 13 fishtail bits, other accesories. Also Fairbanks-Morse 3 x 4 duplex piston pattern pump. V-Belt drive from 9-hp Z.C. engine. All new. Still in shipping crates. Price $4000. Sullivan core drill, model N-Imp. 1900 ft. 2⅞" drill rod, subs and other accessories, trailer mounted on 8.25 x 20 tires. 4 x 10 Gaso pump, just overhauled. Six-cylinder Graham engine as power. Equipment in Deming, New Mexico. Price $5000. Francis Seyfried, P. O. Box 500, Point Pleasant, New Jersey.

■ 2-E.L.I.-M5 shot hole drills. 1 mounted on 4 x 4 Chev. army truck with new motor, new tires. 4 x 4 Chev. water truck with 600 gal. tank, new tires. Drill in perfect condition, 16 mo. old; 1 mounted on 1942 Ford new 100 HP motor, new tires 1942 Ford water truck with 600 gal. tank. Good tires. All in good condition. Present operations Ada, Oklahoma. Will trade for Failing 1500 truck mounted. Write Charles L. Farris, P. O. Box 195, Ada, Oklahoma.

NEW A.P.I. BOLTED TANKS
60—1000 BBL., 415—100 BBL.
IN STOCK N. Y., NEW ORLEANS, LOS ANGELES

DARIEN CORP.
60 E. 42nd St., NEW YORK, N. Y.

ATTENTION DEALERS: For sale at less than wholesale prices—3000 ft. 1" 3 ply rubber air hose, new; 5000 rolls friction tape; 4000 gal. fibre roof coating, cold application; 10 lathe chucks, 14", new; 1000' ⅝ galvanized chain, new; 1000' ⅝ & ¾ chain, new; 4, 75 cubic ft. refrigerators, porcelain in & out, complete with unit & motor, $550.00 each; 1, 5KVA light plant diesel engine; 1, 3 HP battery charger, complete, $50.00; 10 lengths of 10' each conveyors heavy turnbuckles at SURPLUS WAREHOUSE, Abbeville, La.

FOR SALE

Two. Model JL-1335 Buda gas-butane engines, completely overhauled and guaranteed. One equipped with gasoline engine starting unit. Call or write, if interested in these engines at a bargain, to Empire Oil Field Machinery Company, Box 4026 or Phone LD 18, Odessa, Texas.

FOR SALE

1—15,000 foot Rig Complete. Bethlehem MC-950 Drawworks with 4-383 HP 6-G-510 Superior Drilling Engines
2 Pumps
All 300-Ton Equipment in Derrick
Rig in operation less than one year
This rig is one of the largest power rigs in operation

1—12,000 foot Steam Rig Complete
Rig has 14 x 14 Ideal Ajax Engine
No. 12 Beaumont Iron Works w/ Hydromatic Brake
3—20" Pumps
4—125 x 350 Boilers
3-Pump Boiler Feed Unit
All heavy steel connections and all 300-ton equipment in derrick

1—12,000 foot Power Rig Complete
MC-650 Drawworks w/3-LRO Waukesha Motors w/V-Belt Compounds
2 Pumps
All 300-Ton Equipment in Derrick
Rig purchased October, 1946

All rigs are in good condition ready to drill and are priced to sell.

For further information please call telephone 2-6269, Fort Worth, Texas, or write us at 625 Fort Worth Club Bldg.

PIPE—1½" O.D. PLAIN ENDS

Random lengths. Approximate .148 wall. Used but in good condition. Quantities up to 20,000 feet available.

Illinois Electric & Gas Company
Murphysboro, Illinois

HELP WANTED

■ ENGINEERS: Mechanical and Structural by leading manufacturer of oil field drilling and servicing equipment. Experience in oil field or allied equipment desirable. Permanent to those who qualify. State education and experience. Address: Box 31W, c/o World Oil, Houston, Texas.

■ NEW CASING PERFORATING ORGANIZATION has openings for men with experience as shooter or shooter's helper. Excellent opportunity for advancement. Please give personal data, education, experience, and present connection in your first letter. Address: Box 33W, c/o World Oil, Houston, Texas.

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PIPE GRINDING MACHINE designed and built to give pipe line contractors maximum service in polishing the bevel on plain end pipe in preparation for welding. The machine can be placed on pipe easily and quickly, and will clean the bevel on 24-inch pipe in 15 seconds, whereas a man with file would have to work at least 15 minutes. The grinder is constructed for durability, light weight, effectiveness and economy. Electrically driven, it may be operated from electric welding machines on the line.

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NEW Books

Pennsylvania Petroleum

"Pennsylvania Petroleum, 1750-1872, A Documentary History," is a new book by Paul H. Giddens, professor of history and political science, Allegheny College, and Curator, Drake Well Memorial Park.

Information was compiled from original documents—letters, newspapers, out-of-print books, oil company records and reminiscences. Much of the material has never been published. Other portions have been inaccessible to the public. The major portion of all the material was obtained from the library of the Drake Museum.

The book will serve as a valuable reference work for schools and colleges, the oil trade, and the general public. The book has been divided into five chronological divisions, the last of which contains in part the following information: transportation of oil, the first refineries, famous oil wells, speculation in oil stocks, experiments with oil as fuel, the Roberts torpedo, methods of drilling, songs and poetry about oil and the early pipe lines.

Professor Giddens has been Curator of the Drake Museum since 1943. He is the author of two previous books on petroleum history, "The Birth of the Oil Industry," 1938, and "The Beginnings of the Petroleum Industry," 1941; and he has contributed many historical articles to oil journals and other magazines.

The Pennsylvania Historical and Museum Commission and Drake Well Memorial Park.

Petroleum Technology

The first postwar edition of *Petroleum Technology*, which is an annual publication of the Institute of Petroleum, is off the press. Volume 7 is the first to be published since 1941 and includes the years 1941 through 1945.

This volume has required much research into the scientific, technical and trade literature that has been published during the war. It has collected and reviewed more than 3000 articles of this period. For this reason it is a ready source of information to the research worker and a guide to the student and librarian. The complete subject and name indexes as well as inclusive bibliography make it a much more usable reference.

The following subjects are treated in full length chapters:

Petroleum Geology, Geophysics, Drilling, Production Engineering, Petroleum Transportation in the U. S., Refinery Process Developments, Analysis and Testing, Chemistry of Petroleum, Physics of Petroleum, Natural Gas, Liquefied Petroleum Gases, and Natural Gasoline; Benzole, Alternative Fuels, Specifications for Service Fuels, Diesel Fuel and Gas Oils, Wartime Specifications for Lubricants, Asphaltic Bitumen and Road Materials, Special Products, Petroleum Literature.

Micropaleontology

"Principles of Micropaleontology" is a comprehensive book-length treatment of this subject. The author is Martin F. Glaessner, Ph.D., chief paleontologist with the Australasian Petroleum Company and lecturer in Micropaleontology at Melbourne University. Dr. Glaessner first published this book in Australia late in 1945.

He has made excellent use of his extensive experience in research, teaching and application of paleontology to petroleum exploration in Europe, Russia and the Pacific Region. The original plan of this work was developed in a series of lectures given at the University of Moscow in 1936-1937.

In the last 20 or 30 years the study of microscopic fossils has become an important branch of geological science. Its value has been recognized and is clearly demonstrated by the many hundreds of micropaleontologists employed in the petroleum industry throughout the world. The treatment of the subject in this book may assist, to some extent, those interested in the study of microscopic organisms of the past and in their significance for stratigraphic geology. The book will be useful not only to petroleum geologists and paleontologists but to teachers of these subjects as well.

Dr. Glaessner's book deals with virtually all the major groups of microfossils; with primary emphasis, however, on paleontology of the Foraminifera. The section devoted to stratigraphic micropaleontology is especially significant, because of the full discussion of petroleum exploration and oil field practice in Europe, Asia and adjoining oil-bearing regions.

The appendix consists of a synopsis of a revised classification of foraminifera and of the stratigraphic ranges of important genera.

John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. Price: $6.

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■ GEOPHYSICIST, geologist and engineer, technical and practical experience, desires situation. Address: Box 29W, c/o World Oil, Houston, Texas.

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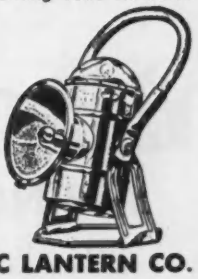

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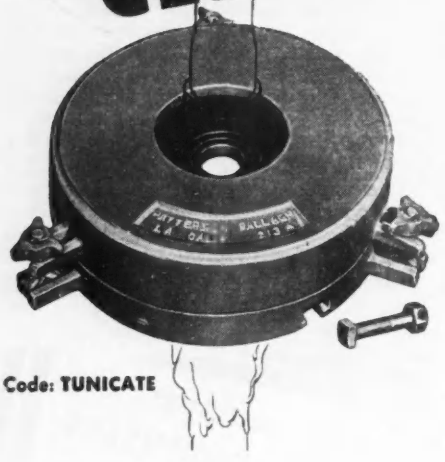

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SQUEAKS from the BULLWHEEL

Hospitality Limited

Joe was very proud of his new house and took his friend Jack home with him to show it off. "My wife isn't in," said he, "so I'll show you her bedroom first." But when the door was opened, Jack was shocked to see that Joe's wife was very much at home, and what's more there was a man with her.

Joe said nothing, but led the way to the kitchen and started rummaging through the pantry.

"What—what are you going to do?" stammered Jack, thinking his friend was looking for a gun.

"I'm going to make some coffee."

"But what about that guy upstairs?"

"Oh, to heck with him. Let him make his own coffee!"

Dumb Doggie

Three men and a dog were playing draw poker when a kibitzer walked up and stared in amazement at the pooch.

"Wonderful! Think of it! A dog playing poker."

At that, the dog turned toward him and scowled. "What's so dern wonderful about it? I ain't won a hand till yet!"

Going Up

It was during an auction that the proceedings were halted and the auctioneer announced: "A gentleman in the room has just lost a wallet containing $1000. He offers $250 for its return to him."

There was a brief pause, then that inevitable voice came from the rear: "$255!"

Future Police Chief

A candidate for the police school was taking a verbal examination.

"Suppose you were alone in a police car being pursued by a gang of thugs in another car doing 40 miles an hour. What would you do?"

"Fifty."

The Woman's Way

"I believe you have lost some weight, Mrs. Jones. Are you dieting?"

"Oh, no. I'm losing weight because of all the trouble I'm having with my new maid."

"Why don't you fire her?"

"I'm going to, just as soon as I lose ten more pounds."

Hints for Householders

"For two pins, I'd stop this car and kiss you."

"Here, take these. My hair will come down, anyway."

Information, Please

What good is alimony on a cold winter night?

Special Delivery

"I knew he shouldn't marry her. In just six months' time she's made him a pauper."

"You don't say! Is it a boy or a girl?"

V for Von't Vait!

"Johnny, when you want to go to the washroom, just hold up two fingers."

"How's that going to stop it, teacher?"

This Curious World

When a man marries his secretary he usually finds he has a new treasurer.

At a party there's always rum for one more.

A doctor says 1 million women are overweight. These, of course, are round figures.

We'd make beautiful music together—you're built so much like a piano.

The man who is always horsing around will one day become a groom.

An evangelist recently announced there are 727 sins. He was immediately besieged for his list by people who thought they had been missing something.

He thinks a sandbag is a desert woman.

Women — some women — flee from temptation. Men — most men — crawl away from it with the cheerful hope it will overtake them.

To be happy with a man, you must love him a little and understand him a lot. To be happy with a woman, you must love her a lot and try not to understand her at all.

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